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John Wise

AERONAUT.

A
SYSTEM OF AERONAUTICS,

COMPREHENDING ITS

EARLIEST INVESTIGATIONS,

AND

MODERN PRACTICE AND ART.

DESIGNED AS A HISTORY FOR THE COMMON READER, AND
GUIDE TO THE STUDENT OF THE ART.

IN THREE PARTS.

CONTAINING AN

**Account of the various attempts in the Art of Flying by Artificial Means,
from the Earliest Period down to the Discovery of the Aeronautic
Machine by the Montgolfiers, in 1782, and to a later Period.**

WITH A BRIEF HISTORY OF THE AUTHOR'S FIFTEEN YEARS'
EXPERIENCE IN AERIAL VOYAGES.

ALSO, FULL INSTRUCTIONS IN THE ART OF MAKING BALLOONS, PARACHUTES,
ETC. ETC., AS ADAPTED TO THE PRACTICE OF AERIAL NAVIGATION,
AND DIRECTIONS TO PREPARE EXPERIMENTAL BALLOONS.

BY JOHN WISE,
AERONAUT.

> "There are more things in heaven and earth, Horatio,
> Than are dreamt of in your philosophy."

PHILADELPHIA:
JOSEPH A. SPEEL,
96 CHERRY STREET ABOVE SIXTH STREET.
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AS A TRIBUTE OF RESPECT AND ESTEEM,

THIS WORK

IS

MOST RESPECTFULLY DEDICATED

TO

PROFESSOR J. K. MITCHELL,

OF PHILADELPHIA,

FOR THE VALUABLE PHILOSOPHICAL SERVICES HE RENDERED ME WHEN I COMMENCED THE INVESTIGATION AND PRACTICE OF AERONAUTICS.

JOHN WISE.

PREFACE.

My determination to prepare this work was induced more from the existing necessity of such a book, than from a desire to figure as an author. A vacuum exists in our common libraries on this much neglected but important subject. The student heretofore, has been obliged to grope his way through the dark, as far as practical information was desirable, while engaged in the investigation of the art and mystery of aeronautics, except what little light he found in the larger Encyclopædias, and these afford but a meagre assistance to the practical experimentalist. The details of manufacturing, inflating and sailing of balloons, are scarcely touched, and the prescriptions and instructions which are to be found in these works, and general receipt books, are mainly theoretical deductions, which are more apt to lead the searching student into difficulties, than to promote the object of his pursuit. This arises from the circumstance of the writers not being *practically* acquainted with the subject they write about, and holds particularly strong in the case of describing the composition and preparation of varnishes and other necessary requisites to the practice of successful ballooning.

Upon so important a question as that of aeronautics, which, at best, has advanced but little since its first discovery, compared with other sciences (more from a want of information in it, however, than a deficiency of intrinsic merit), it becomes essentially necessary that the writer should have acquired his knowledge in the school of experience, in order to make his book valuable and useful in the promotion of the art of aerial navigation.

Having passed through an experimental ordeal of fifteen years, and made nearly a hundred aerial voyages, and constructed all the necessary machinery for its operations, it will be admitted that I must have acquired more instructive and substantial knowledge, and must also, therefore, be more competent to impart it to others, than the merely theoretical looker on. During all this time I was equally interested in the study of the early history of the subject, and consequently sought most diligently for all the information that had been written and authenticated concerning its earlier investigations.

As regards that part of the work, it had to be necessarily brief, unless fabulous and superstitious accounts would have been taken as matter pertinent to the subject, which could hardly have been deemed admissible to a sober history.

With a few exceptions, plausible accounts and mathematical deductions were only considered; and these are but sparingly interspersed among the romantic and fabulous stories which seem to have been built upon them. It was often difficult to find out who the real or original authors of these accounts were—and whether they were writing from personal knowledge or from hearsay; and, indeed, in regard to most of them, it would seem of little account to us, since the inventors of these flying machines mainly attribute the particular excellences of their discoveries to some patron saint's spiritual power, notwithstanding they used many wheels and pinions in their aerial apparatus.

In the second part of the work—comprising an account of my long experience in the practice of ballooning, I have endeavored to combine the highest degree of interest to the common reader, with as much useful instruction to the student of the art as my numerous and most interesting aerial voyages have enabled me to produce. Meteorological phenomena, being so intimately connected with the practice and science of aeronautics, are described, as far as they developed themselves in my voyages, just as they presented themselves to my observation. I flatter myself that this part of the work will prove itself interesting to all classes of readers, because it embraces a pleasing and grand scope to the human mind.

The third part of the work, comprising the philosophy, theory and practice of the art, with full and complete instructions for making all necessary aeronautic machinery, is written with a view of bringing the subject fairly to the comprehension of the minds of the common searchers, promoters and practitioners of the art, and is, therefore, given in a plain style, easily to be understood, believing that in this way it would best attain the end for which it is designed.

In conclusion, I would state with candor, that my whole object has been to bring this much neglected art into a state of progression adequate to its easy acquirement and simplicity, for the purpose of dispelling the delusion manifest in so many persons of its intricacy and its danger; and thereby bring into the field of aeronautics the genius of our favorably gifted country, which must inevitably place aerial transition as far before railroad and steamboat transition, as the latter are before the old-fashioned sail and horse-power modes, and impart its advantages to the present rising generation.

With these views, and the natural sentiments arising from them, I submit this work to the public with as much freedom and confidence as I ever did my balloon and person to the vast element that surrounds us, and with a full conviction on my mind that the shocks of criticism and of praise it must meet with, will be as mingled and severe as were the plaudits and censures of my fifteen years' eventful experience as a professional aeronaut.

JOHN WISE.

Lancaster, 1850.

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A SYSTEM OF AERONAUTICS.

PART I.

HISTORY OF FLYING BY ARTIFICIAL MEANS.

CHAPTER I.

Introduction—Archytas' artificial flying pigeon—Antonius Byerlink's account—Deception on the Emperor Basil of Macedonia—Roger Bacon on air sailing—His ingenious writings interdicted—Training up children to fly—Running and flying.

From the records of the earliest history, we learn that the mind of man was diligently directed to the investigation and discovery of the art of flying, and navigation of the atmosphere. That such a desire has been co-existent with the earliest advances of civilization, is not strange, nor to be wondered at, when we behold the easy and graceful faculty of locomotion enjoyed by the feathered race. There are few of us who have not viewed the flight of our native hawk and vulture with mingled feelings of envy and admiration. To see them soaring aloft, with apparently motionless wing, until the eye can scarcely trace them in the mazy heights of the atmosphere, at once excites the mind to a desire of enjoying their mode of transition, which, together with its speed and facility, would also enhance the intellectual privilege of feasting upon the wide expanse of beauty, which adorns the earth beneath the aerial traveler. The ancients, for a long time, attributed this felicitous prerogative of the feathered race to a supernatural agency, and consequently looked upon them as a species of the Deity. Many traditions of this sort are handed down to us through heathen mythology.

The ancient path of knowledge was obscure and intricate, until the superstitious notions of horned deities, flying oracles, and winged horses, began to be dispelled from the pages of philosophy. The unlearned in ancient times looked upon the operations of the artist with fear and reverence, while the initiated, through motives of self-aggrandizement, wrapped the veil of mystery more closely around their learning. During later ages, in which natural philosophy began to take the place of superstitious mysteries and occult delusions, the arts and sciences progressed more rapidly; and, since the art of printing has been discovered, mankind has become more equalized in the pursuit of knowledge. From that period, history and ingenuity assumed a nobler feature; the monopoly of learning, possessed and exercised by a chosen few, was broken up; the invention of John Faust, in the hands of John Guttemberg, started a new era in 1470, which gave a new and vigorous impulse to all kinds of improvement within the province of mankind. The faculty of flying, as well as other mysteries, was thenceforth examined more upon natural principles, in order to test the possibility of applying it to the use of the human family.

But let us return, for a moment, to the earliest writings for accounts of machines for traversing the upper heavens, and bring down a connected history of man's propensity to acquire so desirable an art, to the present time. We shall then surely see, if not in the present, at least in an approximating future, a very encouraging prospect of its fullest realization; not merely as a means of pleasurable enjoyment, but also to carry on the most extended and magnificent commercial and scientific pursuits.

The first account on this subject that we find on the records of history, that carries with it anything like plausibility, and to which nearly all modern writers on the art of flying make reference, is that of Archytas' artificial pigeon. This great geometrician was of the Pythagorean school, and flourished about four hundred years before the Christian era. The account of it is given by the historian Aulus Gellius, who wrote during the time called the "Brazen Age." He says, that "Archytas constructed a wooden pigeon which could fly by means of mechanical powers and an *Aura Spirit.*" In the description of the construction of this artificial flying pigeon, the machinery is, in some measure, explained. Its buoyancy seems to have been effected by magnets; but the moving, or rather the propelling, power is attributed to an occult—a very indispensable accompaniment to ancient works of wonder, of which we have *only* descriptions.

Another writer, in reference to this artificial bird, says: "Archytas, philosopher of Taranto, constructed a wooden pigeon which could fly; but if it fell to the ground, it could not raise itself up again."

Much has been written about this wonderful piece of art during the last three centuries, the most important of which we find in the writings of Cardan, Scaliger, Fabri, Lana, and others. But most of these authors, like the historian Gellius, have their descriptions involved with obscure proceedings—throwing but little light on the path of discovery of aerostation. Writers of a more modern date intimate that by the enclosed "aura spirit" might be meant rarefied air, or hydrogen gas, and the mechanical artifice connected with it, to have been used for the purpose of giving it direction. These suppositions fall to the ground when we examine the subject closely. If gas or rarefied air had been used to give it buoyancy, the machine would necessarily have been of great size, so much so, that it could hardly have retained much resemblance to a pigeon (and all the writers who refer to the subject call it a pigeon), and yet none of them make mention of its being of extraordinary size. Besides this, the process of inflation either with rarefied air or hydrogen gas would have been so conspicuous a part of its operations, that it could not well have been overlooked by those who saw it and wrote about it, without some account of the process being given in its history. It is not in the least probable that Archytas had any knowledge of the gases —and it is also very doubtfully maintained, that he made his pigeon fly to any considerable extent or height. Such an opinion is confirmed by the writer who says, "When it fell to the ground, it could not raise itself up again."

It would be unnecessary to go into a critical investigation of the merits of Archytas' invention, were it not that nearly all subsequent accounts of flying machines are too dependent upon this tradition for their proof of success; many of them blending it with their own fanciful notions, and throwing around them an air of mystery and secrecy, well calculated to delude the unlearned into the belief that it required the aid of a spiritual agency, which could only be acquired by those whose learning entitled them to hold communion with saints and demons.

It is not remarkable that, at a period when all civilized Europe was shrouded in ignorance, and labored under the tortures of iron-handed tyranny, such doctrines should have elicited the admiration and awe of the multitude, and more especially so, when even the tenets and history of the church of that day were embellished with accounts of flying temples, flying dragons, flying saints, and flying witches.

The next account that we find particularly noticed in history is that of a man, who, it is said, flew high in the air in the city of Rome, under the reign of Nero, but lost his life in the descent. (An unfortunate fatality which terminated many of the ancient experiments in flying.) This adventure is related by Antonius Byerlink, who endeavors to substantiate the circumstance by a description of the ingenuity and mathematical precision of the artist's wings and apparatus; but concludes with a vague intimation that the individual's evil genius became displeased with him when aloft, and consequently suffered him to fall down.

Here, again, we find that the machinery, critically exact as it may have been, could not of itself accomplish the design for which it was constructed. The apparent flight of these objects must have been delusive. At that period, the magic art was expertly practiced. We have an example in the case of the Emperor Basil of Macedonia, as it stands written in "Brewster's Letters on Natural Magic." "Inconsolable at the loss of his son, this sovereign had recourse to the prayers of the pontiff Theodore Santabaren, who was celebrated for his power of working miracles. The emperor, in short, saw the aerial image of his son on horseback, and as the picture was brought nearer the mirror, the image advanced into his arms, when it, of course, eluded his affectionate grasp." This art being well understood by the ancients, may have been the means of giving effect to the delusion of flying machines, such as Archytas' pigeon, and others referred to by those historians.

Roger Bacon, an eminent philosopher of the thirteenth century, who, from his genius and ability, won for himself the title of "The Admirable Doctor," was the first to whom we are indebted for an approximation to the true principles of aerostation. He wrote upon various subjects, and displayed in all a great power of imagination, with an equal degree of enterprise. The knowledge he possessed, and the theories he laid down, appear the more remarkable, because we have, within the last hundred years, realized several of his most magnificent schemes. Like Franklin, his ideas and knowledge were three or four centuries ahead of the age he lived in. The art of sailing in the air, or, at least, the principle by which it is accomplished, seems to have been so well understood by him, that we may safely ascribe to him the discovery of its main principle (atmospheric buoyancy), which we will presently perceive.

In one of his works, he descants, in glowing language, on the possibility of constructing engines of immense size and power, that could traverse the land and the water with great speed, and carry with them persons and merchandize. He then goes on to describe a plan of navigating the air. He assumes that the atmosphere is a material of some consistency, capable of bearing upon its *surface* vessels, like ships are borne upon the surface of the water. He next describes the construction of his aerial machine, "which," he says, "must be a *large hollow globe* of copper, or other suitable metal, wrought extremely thin, in order to have it as light as possible. It must, then," he says, "be filled with 'ethereal air or liquid fire,' and then launched from some elevated point, into the atmosphere, where it will float like a vessel on the water." It cannot be ascertained, from the writings of Roger Bacon, that he ever realized any of his grand projects of flying, by actual experiment; but, in concluding his treatise upon this branch, he expresses himself thus: "There is certainly a flying instrument, not that I ever knew a man that had it, but I am particularly acquainted with the ingenious person who contrived it."

After expressing himself so confidently upon the "hollow globe" method, he thinks, "There may be made some flying instrument, so that a man sitting in the middle of the instrument, and turning some mechanism, may put in motion some artificial wings which may beat the air like a bird flying."

To these descriptions of Bacon, some of our modern writers have adverted with greater zeal than judgment, to prove that the art of flying by human contrivances was known to the ancients, or, at least, anterior to the discovery of the Montgolfiers. They contend that Roger Bacon was well acquainted with the properties of the atmosphere. Some very learned disquisitions have been written to prove that his *ethereal air* and *liquid fire* were the same as our rarefied air, and hydrogen gas.

With all due deference to the brilliant genius and far-reaching intellect of Roger Bacon, it must still be evident from his own writings that he did not fully understand the principle of atmospheric pressure, or he would not have thought it necessary to get his "hollow globe" on the surface of the atmosphere. As to his having some knowledge of the consistency of the air as an elastic fluid, that will not be denied, for, at that period, the attention of the learned began to be directed to the science of pneumatics; but we have no authenticated writings to show that they had a knowledge of the various and distinct gases.

The discovery of the art of making gunpowder has been attributed to Roger Bacon, and history makes it evident that he accomplished astonishing things in his day, for we read that he was accused of holding communion with the devil, and that the perusal of his writings was interdicted by an order of Nicolas IV., and the Doctor placed under personal restraint, where the emanations of his brilliant mind could only enlighten the emperor and his courtiers. Soon after Bacon's time, projects were instituted to train up children from their infancy in the exercise of flying with artificial wings, which seemed to have been the favorite plan of the flying philosophers and artists of that day. If we credit the accounts of some of their experiments, it would seem that considerable progress was made in that way. The individuals who used the wings could skim over the surface of the earth with a great deal of ease and celerity. This was accomplished by the combined faculties of running and flying. It is stated, that, by an alternately continued motion of the wings against the air, and the feet against the ground, they were enabled to move along with a striding motion, and with incredible speed.

If we are permitted, for a moment, to digress from the historical part of our subject, we will show that this method of locomotion, under the present knowledge of aeronautics, could be turned to considerable account. If, for instance, we take a balloon of limited size, about eighteen feet in diameter each way, it will, when inflated with hydrogen gas, be capable of raising 160 pounds, independent of its own weight. Now, if this be so fastened to a man's body, as not to interfere with the free use of his arms and legs, he may then ballast himself so as to be a trifle heavier than the upward tendency of the balloon, which will be nearly in equilibrio. If then he provides himself with a pair of wings, made on the bird principle, with socket joints to slip over his arms at the shoulders, and a grasping handle internally of each one, at the distance from the shoulder joint of the wing, as the distance is from his shoulder to his hand, he may beat against the air with his wings, and bound against the earth with his feet, so as to make at least a hundred yards at each bound. This the writer has often done, in the direction of a gentle wind, with the aid of his feet alone, after his balloon had descended to the earth; and, on one occasion, traversed a pine forest of several miles in extent, by bounding against the tops of the trees. Such a contrivance would be of inestimable value to exploring expeditions. Landings to otherwise inaccessible mountains; escapes from surrounding icebergs; explorations of volcanic craters; traversing vast swamps and morasses; walking over lakes and seas; bounding over isthmuses, straits, and promontories, or exploring the cloud-capped peaks of Chimborazo, could thus all be easily accomplished.

CHAPTER II.

History resumed—Famous John Muller and his artificial eagle—Dante of Perouse's flight—Cuperus on flying—Bishop Wilkins' propositions on air sailing—Philosophical approximations to the art—Jesuit Lana on air sailing—Besnier's flight—Baldwin bought his wings—De Gusman's petition for a patent for flying—De Bourgois' account—Gallien's book on flying.

In resuming our history, it is related by several authors, each of whom seems to have copied the story from his predecessor, that the famous John Muller, also called Regiomontanus, constructed an artificial eagle at Nuremburg, which flew out to meet the Emperor Charles V., and accompanied him back to town. It is also stated: "About the same period, and in succeeding times, we are told of a certain monk, named Elmerus, who flew about a furlong from the top of a tower in Spain. Another flight was attempted from St. Mark's steeple, in Venice, and also at Nuremburg; and, by means of a pair of wings, a person named Dante of Perouse was enabled to fly; but, while amusing the citizens with his flight, he fell on the top of St. Mary's church, and broke his thigh."

Cuperus, in his treatise on the "Excellence of Man," very ingeniously contends that it is possible for human beings to attain the faculty of flying. He asserts that Leonardo 'da Vinci, the great painter, practiced it successfully; but his account is not well authenticated.

The next writer upon this subject who merits particular attention, we find in John Wilkins, Lord Bishop of Chester, who died in the year 1672. In a work, which he entitled the "Discovery of the New World," he says, "It is a pretty notion to this purpose, mentioned by Albertus de Saxonia, and out of him by Francis Mendoca, that the air in some part of it is navigable; and that, upon this static principle, any iron or brass vessel (suppose a kettle), whose substance is much heavier than that of water, yet being filled with air it will swim upon it and not sink. So, suppose a cup or wooden vessel, upon the outward borders of the atmosphere, the capacity of it being filled with fire, or rather ethereal air, it must necessarily, upon the same ground, remain there, and of itself no more fall than an empty ship can sink."

Wilkins' reasoning here embodies the sentiments and principles of Bacon on this subject, with, however, quainter illustrations to show that the atmosphere is navigable. In tracing the progress of knowledge in relation to the principles of atmospheric buoyancy, it exhibits to the mind a very striking exemplification of the nearness to which we may approach to the desired object of our pursuits, and yet, for the want of knowing correctly the application of a trifling part of it, how long we may be baffled in perfecting our schemes.

We find here, that, for the space of over 400 years, one generation after another conceived more fully the principles and truths of a theory, without any real success towards its consummation in practice. The idea thrown out by Roger Bacon, of atmospherical buoyancy, it does seem from history, had become the favorite theory with the most philosophical portion of the advocates of the doctrine that flying through the air could be accomplished by human beings. The other portion, who were evidently more of a mechanical turn, contended that it must be accomplished by the aid of artificial wings, on the bird principle. Now, that it is not philosophically disproved, that man may fly by the aid of artificial wings, is evident, for it would be no more at variance with the laws of nature than it is for him to swim in the water like a fish.

While Cuperus, upon the one hand, in his treatise on the "Excellence of Man," contends that the faculty of flying, by the use of artificial wings fastened to the body of a man, can be attained, Borrelli, a Neapolitan mathematician, asserts that, after having examined the subject with great nicety, in a comparison of the strength of the muscles of a man to the muscles of a bird, it is impossible to fly by means of wings fastened to the body. Under this view of the subject, we may safely steer a middle course, denying neither the one, nor positively assuming the other, but leaving to the age of improvement in which we live, to decide, by actual experiments, what may be accomplished by both plans.

Bishop Wilkins, in his treatise on mechanical motion, treats expressly of the art of flying by the aid of wings. In the sixth chapter, he says: "Scaliger conceives the framing of such volitant automata to be very easy. *Volantis columbae machinulum, cujus autorem Archytam tradunt vel facillime profiteri audeo.*"

"But this may better be performed by the strength of some such spring as is commonly used in watches. This spring may be applied unto one wheel, which shall give an equal motion to both the wings; these wings having unto each of them another smaller spring, by which they may be contracted and lifted up, so that being forcibly depressed by the strength of the great and stronger spring, and lifted up again by the other two; according to this supposition, it is easy to conceive how the motion of flight may be performed and continued."

Not so very easy, we should suppose, especially in continuing the flight—unless it would be a flight of fancy—which we shall presently show the bishop to have been more expert in, than in any other department of genius. In his seventh chapter, he lays down four different plans by which flying in the air has been, or may be, attempted. To wit: "Firstly, by spirits or angels; secondly, by the help of fowls; thirdly, by wings fastened immediately to the body; and, fourthly, by a flying chariot."

The first one of these propositions is an inheritance of the ancient superstition, as related by Aulus Gellius, in ascribing the power of Archytas' wooden pigeon to an *aura spirit*, and Antonius Byerlink's *evil genius*, which seems to have been the mainspring to this flying artist's machinery.

The second, which depends upon the help of birds, might, to some extent, be realized by the training of some such powerful bird as the condor of South America, which, it is said, can fly off with a sheep or a calf. But such a mode would not seem to be very promising in its results, admitting that it were practicable.

The third, which is to be accomplished by the aid of wings fastened immediately to the body, he recommends more in detail. Regarding this plan, he says: "It is the obvious and common opinion that this may be effected by wings fastened immediately to the body, this coming nearest to the imitation of nature, which should be observed in such attempts as these. This is that way which Fredericus Hermanus, in his little discourse, *De Art Volandi*, doth only mention and insist upon; and if we may trust credible story, it hath been frequently attempted, not without some success. It is related of a certain monk, called Elmerus, about the Confessor's time, that he did, by such wings, fly from a tower above a furlong; and so another from St. Mark's steeple, in Venice; another at Nuremburg; and Busbequius speaks of a Turk in Constantinople who attempted to fly. Mr. Burton, mentioning this quotation, doth believe that some new-fangled wit will, some time or other, find out this art. Though, the truth is, most of these artists did unfortunately miscarry, by falling down and breaking their arms or legs; yet that may be imputed to their want of experience, and too much fear, which must, of course, possess men in such dangerous and strange attempts. Those things that seem very difficult and fearful at the first, may grow very facile after frequent trial and exercise; and, therefore, he that would effect anything in this way must be brought up to the constant practice of it from his youth; trying first only to use his wings, in running on the ground, as an ostrich or tame goose will do, touching the earth with his toes; and so on by degrees learn to rise higher, till he shall attain unto skill and confidence. I have heard it from credible testimony, that one of our nation hath succeeded so far in this experiment, that he was able, by the help of wings, in such a running pace, to step, constantly, ten yards at a time."

In the same chapter, he says, "But now, because the arms extended are too weak, and easily wearied, therefore the motions by them are like to be but short and slow, answerable, it may be, to the flight of such domestic fowls as are mostly confined to the ground, which of themselves we see are quickly weary, and therefore much more would the arm of a man, as being not naturally designed to such a motion."

"It were therefore worth the inquiry, to consider whether this might not be more probably effected by the feet, which are naturally more strong and indefatigable: in which contrivance, the wings should come down from the shoulders on each side, but the motion of them should be from the legs, being thrust out, and drawn in again, alternately, so that each leg should move both wings; by which means a man should, as it were, walk or climb up into the atmosphere; and then the hands and arms might be at leisure to help and direct the motion, or for any other service calculated for them. This conjecture is not without strong probability, and some special advantages above the other."

Now comes his favorite project, and one which has frequently been attempted, but invariably without the least success. "But the fourth and last way seems unto me altogether as probable, and much more useful than any of the rest; and that is by a flying chariot, which may be so contrived as to carry a man within it; and though the strength might perhaps be serviceable for the motion of this engine, yet it were better to have it assisted by the labor of some intelligent mover, as the heavenly orbs are supposed to be turned. And therefore, if it were made big enough to carry sundry persons together, then each of them in their several turns might successively labor in the causing of this motion; which thereby would be much more constant and lasting than it could otherwise be, if it did wholly depend on the strength of the same person. This contrivance being as much to be preferred before any of the other, as swimming in a ship before swimming in water."

Now, some writers have warmly contended that Bishop Wilkins discovered the Art of Flying. So far from this being the case, the most plausible part or plan suggested by him is taken from Roger Bacon's treatise on the subject, which is the Balloon principle. He appears to have been very sanguine that the art could be attained, and much credit undoubtedly is due him for the assistance he has rendered the progress of its discovery. He expressed himself at one time to the effect, that he believed the time would come when it would be as common for a man to call for his wings, when about to prepare for a journey, as it was in his time to call for boots and spurs. From the further investigations and quotations that we will make, it will be seen that Roger Bacon's principle was kept sight of by his successors, in the pursuit of this subject, until it was consummated and realized by the Montgolfiers, and the committee appointed on this subject by the Academy of Arts and Sciences of Paris.

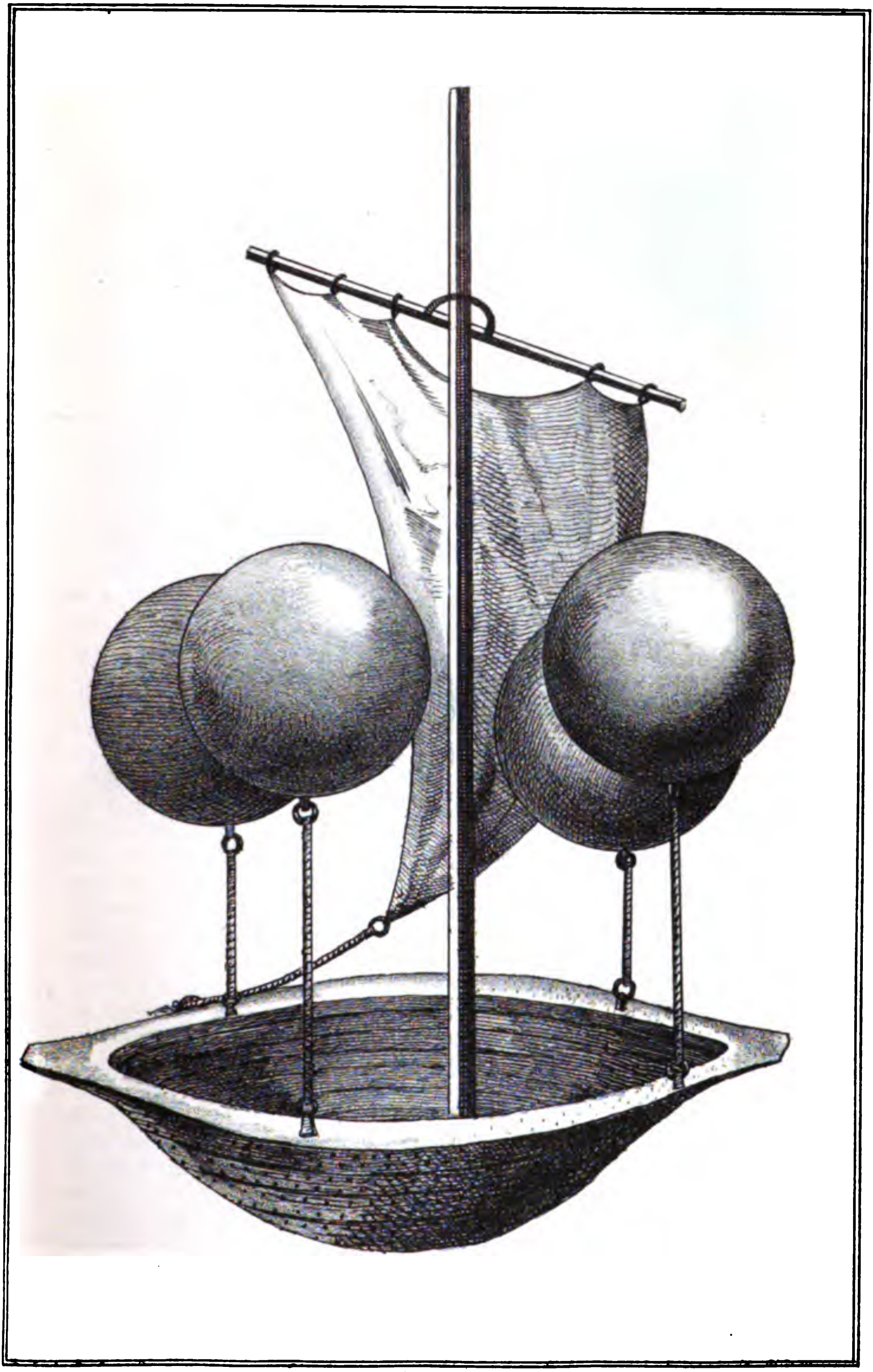
The philosophers, from Bacon's time down to the discovery of the true nature of atmospheric pressure, as illustrated by the Torricellian tube, and air pump, in their speculations upon aerial navigation, all had an opinion that the atmosphere had a defined limit or border, not very high above the earth, upon which the aerial vessel must necessarily be placed in order to have it buoyed up by the air underneath, like the water under a ship. Reasoning from their knowledge of hydrostatics, they took it for granted that the atmosphere was a vast ocean of air surrounding our globe, upon the outer border of which rested another ethereal ocean of a much rarer kind, separate and distinct as the air rests upon the water. Still they approached nearer, in each succeeding generation, to an attainment of navigating the air. Judging, then, from the scanty knowledge they possessed of pneumatics, and indeed of all the sciences, they are entitled to a great deal of credit, in regard to the art of aerial navigation, as also to other important subjects. It does seem that, if the progressive individuals of our generation were to apply themselves with the same earnestness to this subject now, that those did before us whom we have made reference to, it would not be long before we should see air traveling as much preferred and in advance of steamboat and railroad traveling, as the latter are now in advance of the old-fashioned stage-coach and schooner method. In the course of our history, we shall see that the discovery by the Montgolfiers created a spirit for its advancement so far beyond a legitimate end, that we may ascribe to it much of the apathy that has followed it. At the present time, there is, however, a new and sober determination growing up again in the way of improving this neglected art.

The great interest that was manifested in the seventeenth century, from the numerous experiments that were going on in every civilized part of the world, brought into the field many able writers on this subject, which soon revived all the knowledge and history of the past, and created a fresh stimulus to the investigation of all subjects that had any bearing on, or relation to, the improvement of aerial navigation. Hypothetical narrations had now to give way to the more solid principles that naturally suggested themselves under such a state of improvement. Mathematical demonstration was resorted to as the only sure guide to direct the progress of the arts, and thus the veil of mystery could no longer cover the vague pretensions of monopolized learning. The researches of alchemy had also contributed many valuable discoveries towards strengthening the rational philosophy of the day. And from about this period we date the beginning of the most important and useful improvements in the operations of mankind.

Francis Lana, a Jesuit, and a very judicious writer, deduced from the new discoveries the real nature and pressure of the atmosphere, and is the first who established a theory verified by mathematical accuracy, and clearness of perception, which placed him far in advance of his predecessors in the science of aerial navigation. He very truly inferred that a vessel exhausted of air would weigh less than when full of that fluid. He also shows in his problems that the capacity of globular vessels increases much faster than their surfaces. For example, two globular vessels, one of ten feet diameter, and another of twenty feet diameter; the first will have a capacity of 523 cubic feet and a fraction over, while the other will have 4189 cubic feet. The surface of the larger is about four times that of the smaller, while its capacity, or contents, is eight times as great. This is a very important consideration in the construction of balloons. Thus, a balloon that would carry one person, and would weigh one hundred pounds, which is about the weight of such a one, and would cost two hundred dollars; one capable of carrying two persons would not cost more than three hundred dollars, and would not weigh more than one hundred and fifty pounds. Now, a balloon of the power first mentioned would be about twenty feet in diameter, which, when filled with ordinary hydrogen gas, would have an ascending power of two hundred and fifty pounds, while one of five times its diameter, being one hundred feet, would have an ascending power of thirty-two thousand, seven hundred and twenty-five pounds, which would be capable of carrying one hundred and sixty-six men, independent of its own weight and necessary appendages.

Lana proposed to prepare four hollow globes of copper, each twenty feet in diameter, and so thin, that they would weigh less than an equal bulk of atmosphere, when they were exhausted of air. To these globes he designed fastening a boat, in which the aeronaut and his appendages were to be stationed, for the purpose of directing the machine. Although the idea laid down here involves the same principles by which aeronautics are practiced at the present day, still, several obstacles present themselves which must have rendered his plan impracticable. The copper, of which the balloons were to have been made, must necessarily have been so thin, to make the vessels light enough, that they would not have been strong enough to resist the external pressure of the atmosphere when they were exhausted.

The barometer, by which the pressure of the atmosphere is ascertained, was discovered in 1643. The immense weight of the air, as shown by the Torricellian tube, being about fifteen pounds to every square inch of surface, was no doubt the stimulus to Lana's proposition of the copper globes. His work, entitled "Prodromo dell' Arte Maestra Brecia," in which he describes his machine, appeared in 1670, while the air pump was not invented, or at least its invention not made known, until the year 1672. The great pressure of the air, as shown by the barometer, without a knowledge of its specific gravity, would very naturally induce a belief that it possessed a much greater weight than it really has, which is one and two-tenth ounces to the cubic foot. At this rate, Lana's globes of twenty feet diameter would each have displaced 4189 cubic feet, making in all 16,756 cubic feet,



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LANA'S AERONAUTIC VESSEL.

weighing 1256 pounds; so whatever less than this his globes and appendages would have weighed, would have been the ascensive power of his aerial machinery. Now the surface of one of these copper globes would have 1256 square feet, which, at the common pressure of the atmosphere on the surface of the earth, would have an external pressure of 2,712,960 pounds, a force sufficiently great to have crushed it, had it been made light enough to be raised by atmospheric buoyancy. Had Lana known the exact pressure and specific gravity of the air, his mathematical knowledge would have at once suggested to his mind the impracticability of his machinery. Notwithstanding these difficulties present themselves to Lana's plan, there are not wanting advocates of its efficiency. A few years ago, it was attempted in Paris. In this experiment, the balloon was composed of silk, and the vacuum was to have been formed by forcing the balloon open by the aid of light framework arranged with ropes and pulleys fixed in the inside of it.

In the "Journal des Savans," of the 12th of September, 1678, an account is given of one Besnier, a locksmith of Sable, in France, who succeeded in flying. His wings consisted of four rectangular surfaces, one at the end of each of two rods passing over the shoulders of him who used them. The inventor did not pretend that he could rise from the earth, or sustain himself long in the air with them, from the inability to give his apparatus the required power and rapidity; but he availed himself of their aid in progressively raising himself from one height to another until he reached the top of a house, from the roof of which he passed over the neighboring houses. By thus leaving an elevated position, he could cross a river of considerable breadth, or any other obstacle. His first pair of wings were purchased by a Mr. Baldwin, of Guibre, who, it is said, used them with remarkable success. One John Babtiste Dante also framed a pair of wings, with which it is stated he could fly, but that he finally ended his career by breaking his thigh. In pursuing the history of our subject, we next find a letter dated Lisbon, the 10th of February, which was published soon after in some of the scientific journals of Paris, containing with it the copy of an address presented to the King of Portugal, in the year 1709, by a friar called Bartholomew Laurence de Gusman. In this the petitioner represents himself as having invented a flying machine, capable of carrying passengers, and navigating through the air very swiftly. He also requests the privilege of being the sole possessor of the invention, desiring a prohibition against all and every person from constructing a similar machine under a severe penalty. Upon this the king issued the following order in his favor:—

"Agreeably to the advice of my council, I order the pain of death against the transgressor. And, in order to encourage the suppliant to apply himself with zeal towards improving the machine which is capable of producing the effects mentioned by him, I also grant unto him the first professorship of mathematics in my University of Coimbra, and the first vacancy in my College of Barcelona, with the annual pension of 600,000 reis during his life.

"The 17th day of April, 1709."

The drawing of this machine somewhat resembles a bird. Its leading features are mainly embodied in a drawing of a flying machine, published in the "Penny Magazine" some years ago. The effect was to be produced by the wind, which was to pass through several tubes and swell a sail something in the shape of a parachute. In the absence of the wind, it was to be effected by a pair of bellows, assisted by two powerful magnets, and several pieces of amber which were to pull upwards, with other contrivances equally vague and absurd. Indeed, it does appear that this applicant of the king's favor was nothing more than a pretender without ingenuity; for the whole design, as near as it can be traced, is merely a modified form of Archytas' flying bird. In many of the writer's descriptions, a great deal of ingenuity and mechanical skill is manifested, but in the above we have nothing but that never-to-be-forgotten notion, of making a thing lift itself up. And even at this day, we have persons who have erected pumps to pump up water to a head race for the purpose of driving mill machinery, which is about equal to De Gusman's idea of supplying wind by bellows to propel his flying chariot. Of this class of persons are the *wanderers* after perpetual motion.

D. Bourgois, in his "Recherches sur l'Art de Voler," says that, in the above account, the name of De Gusman is wrongly annexed to Bartholomew Laurence, and that they were distinct persons. He tells us that it was Bartholomew Laurence who presented the petition to the king, and of De Gusman he relates the following history: That, in the year 1736, De Gusman made a wicker basket of about seven or eight feet in diameter, covered with paper, which basket elevated itself as high as the tower of Lisbon. This author says that he learned this from a very creditable person, who witnessed the experiment. But that, for better confirmation of it, he wrote to a distinguished merchant of Lisbon, who answered him that it was true, and that many persons still remembered it, though they attributed it to witchcraft.

Joseph Gallien published a book in 1755, at Avignon, entitled "L'Art de Naviger dans les Airs," in which he asserts that a bag of cloth or leather, filled with an air lighter than that of atmosphere, might be used with perfect security for the purpose of aerial voyages. Had Gallien been acquainted with hydrogen gas, and the means of its production, the honor of the discovery of aerostatic machinery would no doubt have fallen to him. It may be possible that De Gusman's machine was nothing more than a paper vessel kept distended by a wicker frame, and made to rise by heating the air within it, which might have been accomplished without having fire attached to it when it ascended. By passing it in very hot, and suddenly letting it go, it would rise some distance. This idea is strengthened, from the mention that is made of its rising up two hundred feet, and immediately coming down again. However, as De Gusman never made known the principle by which his machine was elevated, the merit of discovery can not be awarded to him.

A great many experiments were now put in progress to solve the problem of atmospheric buoyancy, and indeed a number of persons contended that they were the first who discovered it, after it was really solved. We shall, therefore, refer to the most noted authors on this subject, concerning its discovery, who wrote immediately after it was made.

CHAPTER III.

Discovery of aerostatic machines—Experiments—Academy of Arts and Sciences of Paris taking it in hand—Excitement of the French people about it—A sheep, cock, and duck the first aerial adventurers—De Rozier and Marquis de Arlandes ascend with a fire balloon—Particulars of their voyage—Procès verbal—Experiment of Rittenhouse and Hopkinson—Experiments with inflammable air—Cavallo on the discovery of the hydrogen balloon—Experiments at Lyons with a mammoth fire balloon—Experiments at Milan.

After progressive researches and repeated experiments, during the lapse of more than twenty centuries, the art of aerial navigation was at length discovered in the year 1782, in France. When we consider the attention that was paid to the subject, during its progress through so many years, by the most learned men, we may reasonably expect that much more will be done to improve its present condition, and make it what it can be, and ought to be made; the most expeditious, easy, and pleasant mode of traveling that the human family is capable of enjoying.

After the elasticity of air was discovered, and its real weight and nature ascertained, it would seem that no great difficulty lay in the way to make a successful experiment. But this, like almost every other important discovery, was in the end attained by indirect means, rather than from purely pre-considered and tried experiments on the subject. It may be that Bacon's and Lana's notions of the atmosphere's *surface* suggested the idea of the cloud and smoke principle. However, as we have no information that the Montgolfiers had particularly devoted any of their pursuits to the discovery of aerostatics, it does rather appear that the idea was spontaneously suggested.

The natural ascent of smoke and clouds, it appears, first drew the attention of the two brothers, *Stephen* and *Joseph Montgolfier*, to make their aerostatic experiment. Stephen, the younger of the two brothers, concluded in his mind, that, if a light paper bag were to be made and filled with *cloud* or *smoke*, either of these substances, from their natural inclination to rise, would carry the bag with it in an upward direction. Accordingly, a light paper bag of an oblong shape was made, of a capacity of about forty cubic feet. With this they made their first experiment in a private manner in their own chamber, at Avignon, about the middle of November, 1782. The lower part of the bag had an orifice to which they applied burning paper, upon which it began to distend itself, and in a few minutes sustained itself by being held at its lower part, when, on being released, it ascended to the ceiling of the chamber, where it remained a few moments, much to the joy and astonishment of its projectors. Moved on by this pleasing experiment, they next tried it in the open air. Here, again, after it was inflated and released, it ascended, reaching a height of about seventy feet.

Encouraged by this success, the experiment was next to be made on a larger scale. For this purpose, an envelop of a capacity of about 600 cubic feet, and of a spherical shape, was made. Upon trial, this experiment far exceeded their most sanguine expectations. This balloon (for this was made after the shape of a *balloon*, "a large, round, short-necked vessel used in chemistry," and hence the name of balloon for aerial ships), after being inflated in the same manner as the former, became so strong that it broke the strings by which it was to be retained a certain distance above the earth, and ascended to a height of about six or seven hundred feet, and alighted soon after upon the adjoining ground.

Finding, upon these trials, that, as they enlarged their machines, the balloons, they succeeded better, they concluded to build one of thirty-five feet in diameter. Such a balloon was accordingly constructed, and the 3d day of April, 1783, was fixed on to make the experiment. When the appointed day came, the wind was so violent that it was thought most prudent to defer it until the 25th of same month. This proving a more favorable day, the trial came off handsomely, and with unbounded applause from those who were in attendance. The balloon, after being filled and released, rose very suddenly into the air until it reached a height of at least 1000 feet, and fell to the ground at the distance of three quarters of a mile from the place it had ascended. It was now concluded by the Montgolfiers to make a public experiment with this last constructed balloon, on the 5th of June following. Accordingly, invitations were extended, and, as might naturally be expected, a great concourse of spectators assembled to witness the novel and extraordinary sight. This balloon, being of a spherical form, thirty-five feet in diameter, had a capacity of nearly 23,000 cubic feet. It was inflated over a pit, or well, in which were burned *chopped straw and wool*, over which the lower orifice of the balloon was placed by swinging it from a cross rope fixed up for the purpose. When it was fully inflated with heated air, it was found to have an ascending power of 500 pounds. As it displayed its huge dimensions, the spectators gave vent to loud exclamations and shouts of applause. In a few moments after it was filled, it was released from its fastenings, and ascended majestically, amidst the most deafening shouts of approbation. It rose to the height of six or seven thousand feet, and fell to the ground at the distance of a mile and a half from its point of departure.

After this demonstration, this wonderful invention was heralded to every part of Europe with a rapidity that its importance had naturally inspired. The particulars, as stated in one of the journals of the day, are as follows: "On Thursday, the 5th of June, 1783, the States of Vivarais being assembled at Annonay, Messrs. Montgolfiers invited them to see their new aerostatic experiment. An immense bag of linen lined with paper, and of a shape nearly spherical, had its aperture, which was on its inferior part, attached to a frame of about sixteen feet surface, upon which it lay flaccid like an empty linen bag. When this machine was inflated, it measured 117 English feet in circumference; its capacity was equal to about 23,000 cubic feet; and it had been calculated that, when filled with the vapor proper for the experiment, it would have lifted up about 490 pounds, besides its own weight, which, together with that of the wooden frame, was equal to 500 pounds, and this calculation was found to be pretty true by experience. The bag was composed of several parts, which were joined together by means of buttons and holes, and it is said that two men were sufficient to prepare and fill it, though eight men were required to prevent its ascension when filled."

Other accounts give a still more glowing description of this wonderful experiment; but, as the one we quoted seems to be given with soberness and accuracy, we prefer it to any of the rest. The conflicting opinions in regard to the possibility of such a thing; the doubts of others; with an ardent degree of credulity manifested by those who had either seen, or positively heard of its having been done before, all combined to give the occasion an extraordinary character.

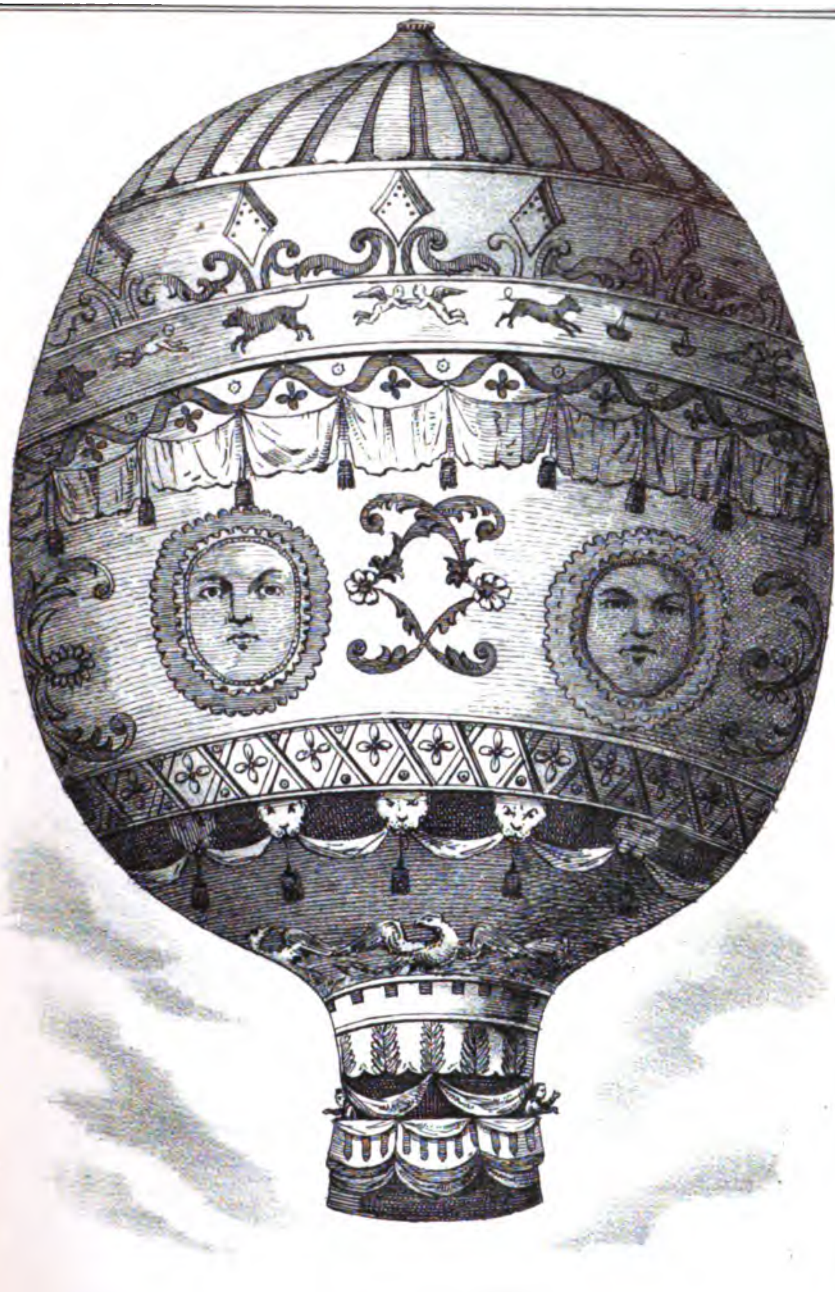
This occasion dated an epoch in the history of aeronautic science. The subject was now taken up with renewed vigor. Various claims were also set up for its discovery. Cavallo intimated that he had made the first air balloons, but concedes the right of discovery to the Montgolfiers. He says, in speaking of this subject, "The weight and elasticity of the air were well known to the ancient philosophers, as may be deduced from several passages in their works. Borrelli relates an experiment of a Florentine, called Candido Buono, which shows that air, rarefied by heat, becomes lighter, and ascends amid the colder air. This easy, and at the same time satisfactory, experiment consists in bringing a red-hot iron under one of the scales of a balance, when that instrument hangs in equilibrio; for as soon as the red-hot iron is brought under one of the scales, the air, heated and rarefied by it, will ascend, and will impel the said scale upwards, the opposite scale descending as if a weight were put to it."

Whatever knowledge may have existed on this point, it is evident, from the history of the case, that the Montgolfiers did not make the discovery on that account. And if they even had, it would not detract from the merit of their discovery. It would seem that they rather based the idea of success in having discovered how to make artificial clouds, supposing they were constituted of a vapor or gas specifically lighter than atmosphere. This doctrine was even maintained by the advocates of the Montgolfierian system, after the hydrogen balloon was introduced.

Soon after the experiment had been made at Annonay, Stephen Montgolfier arrived in Paris. He was immediately invited to attend the sitting of the Royal Academy of Sciences, and by that body requested to repeat his experiment at their expense. He cheerfully accepted the proposition, and soon constructed a large balloon of an elliptical shape, seventy-two feet high, and forty-one feet in diameter. When completed, it was found to weigh 1000 pounds. It was finished and decorated in a most magnificent style; elegantly ornamented over its outer surface with beautiful and appropriate designs. At a preliminary experiment, it raised eight men from the ground. On the 12th of September, 1783, the day appointed for its exhibition before the members of the Royal Academy, it ascended with a load of from four to five hundred pounds. But, owing to a violent gust of wind at the time, it was damaged in the ascent, which prevented the machine from attaining a great height. Upon its descent, it was found to be so much damaged, that a new one of nearly the same dimensions was ordered to be made. To this was added a basket of wicker-work. It was then inflated in the presence of the king and royal family, at Versailles, and a sheep, a cock, and a duck were placed in the basket. With these three living animals as its passengers, it was launched into the upper air, when it ascended to the height of about 1500 feet. Owing to a similar accident that befell the other, it did not rise so high as it otherwise would. The animals, however, landed safely with it at a distance of 10,000 feet from the place of ascent.

This was the first experiment in which any living creature ascended with an aerostatic machine. Another was now constructed which was seventy-four feet high, and forty-eight feet in diameter. With this large balloon, M. Pilatre de Rozier volunteered to make an aerial voyage. This machine had an opening at the bottom end of about fifteen feet in diameter. Around this opening was arranged and fastened a gallery of wicker-work, three feet broad, and around the outer edge of this was a balustrade of the same material, three feet high, and around the lower circumference of the balloon, and immediately above the gallery platform, port-holes were worked in it, for the purpose of introducing fuel. From around the lower aperture of the balloon, chains were suspended, to which was fastened an iron brasier, intended for the fire-place, on which the aeronaut could easily introduce his fuel from the port-holes, as necessity required it. With this machine, M. Pilatre de Rozier made several ascents to the height of two or three hundred feet, while it was fastened by ropes of that length. On the 21st of November, he, in company with the Marquis d'Arlandes, concluded to make an aerial voyage. Accordingly, the balloon was inflated, and the gallery supplied with fuel, whereon M. Pilatre de Rozier and the Marquis d'Arlandes stationed themselves on opposite sides of the gallery, when, at a given signal, the balloon was released from its moorings and left free in the air. It rose majestically amidst the shouts and applause of a delighted multitude, until it attained a height of 3000 feet. The whole machine, with fuel and passengers, weighed 1600 pounds. They remained in the air twenty-five minutes, and encountered several different currents of wind. During this voyage, they were several times in imminent danger by the balloon taking fire. The marquis became greatly agitated at this, and desired to make a precipitate descent, which might have ended the adventure with serious consequences. But the coolness and intrepidity of M. Pilatre de Rozier prevented them from incurring this danger, as he had provided himself with a sponge and water for the emergency, with which he very deliberately extinguished the fire, which enabled them to remain in the atmosphere some time longer. They raised and lowered themselves frequently, during this excursion, by regulating the fire in the brasier, and finally landed in safety five miles from where they started, after having sailed over a great portion of Paris. Previous to this voyage, M. Pilatre de Rozier ascended several hundred feet high, in company with M. Girond de Vilette. We will here give the original documentary account of this most interesting aerial voyage.

Procès Verbal.—"To-day, November 21, 1783, at the chateau de la Muette, took place an experiment with the aerostatic machine of M. de Montgolfier. The sky was partly clouded, wind northwest. At eight minutes after noon, a mortar gave notice that the machine was about to be filled. In eight minutes, notwithstanding the wind, it was ready to set off, the Marquis d'Arlandes and M. Pilatre de Rozier being in the car. It was at first intended to retain the machine awhile with ropes, to judge what weight it would bear, and see that all was right. But the wind prevented it rising vertically, and directed it towards one of the garden walls; the ropes made several rents in it, one of six feet long. It was brought down again, and in two hours was set right. Having been filled again, it set off at fifty-four minutes past one, carrying the same persons. It rose in the most majestic manner, and when it was about 270 feet high, the intrepid voyagers took off their hats, and saluted the spectators. No one could help feeling a mingled sentiment of fear and admiration. The voyagers were soon undistinguishable; but the machine, hovering upon the horizon, and displaying the most beautiful figure, rose at least 3000 feet high, and remained visible all the time. It crossed the Seine, below the barrier of La Conference; and passing thence between the Ecole Militaire and the Hôtel des Invalides, was in view of all Paris. The voyagers, satisfied with their experiment, and not wishing to travel farther, agreed to descend; but, seeing that the wind was carrying them upon the houses of the Rue de Seve, Faub. St. Germain, they preserved their presence of mind, increased the fire, and continued their course through the air till they crossed Paris. They then descended quietly on the plain, beyond the New Boulevard, opposite the mill of Croulebarbe, without having felt the slightest inconvenience, and having in the car two-thirds of their fuel. They could then, if they had wished, have gone three times as far as they did go, which was 5000 toises, done in from twenty to twenty-five minutes. The machine was seventy feet high, and forty-six feet in diameter; it contained 60,000 cubic feet, and carried a weight of from 1600 to 1700 pounds. Given



P. S. Duval's Steam lith Press.

MONTGOLFIER'S BALLOON.

at the chateau of La Muette, at five in the afternoon. Signed, Duc de Polignac, Duc de Guisnes, Compte de Polastron, Compte de Vaudreuil, D'Hunaud, Benjamin Franklin, Faujus de St. Fond, Delisle, Leroy, of the Academy of Sciences."

The following is an extract from a letter written by the Marquis d'Arlandes to M. de St. Fond, concerning this first aerial voyage, dated November 28th, 1783: "We set off at fifty-four minutes past one. The balloon was so placed that M. Rozier was on the west, and I on the east. The machine, says the public, rose with majesty. I think few of them saw that, at the moment when it passed the hedge, it made a half turn, and we changed our positions, which, thus altered, we retained to the end. I was astonished at the smallness of the noise or motion occasioned by our departure among the spectators; I thought they might be astonished and frightened, and might stand in need of encouragement, so I waved my arm with little success. I then drew out and shook my handkerchief, and immediately perceived a great movement in the yard. It seemed as if the spectators all formed one mass, which rushed by an involuntary motion towards the wall, which it seemed to consider as the only obstacle between us. At this moment, M. de Rozier called out, 'You are doing nothing, and we do not rise.' I begged his pardon, took some straw, moved the fire, and turned again quickly; but I could not find La Muette. In astonishment, I followed the river with my eye, and at last found where the Oise joined it. Here, then, was Conflans; and, naming the principal bends of the river by the places nearest to them, I repeated Poissy, St. Germain, St. Denis, Seve; then I am still at Poissy or Chaillot. Accordingly, looking down through the car, I saw the Visitation de Chaillot. M. Pilatre said to me at this moment, 'Here is the river, and we are descending.' 'Well, my friend,' said I, 'more fire;' and we set to work. But, instead of crossing the river, as our course towards the Invalides seemed to indicate, we went along the Ile des Cygnes, entered the principal bed again, and went up the stream till we were above the barrier La Conférence. I said to my brave associate, 'Here is a river which is very difficult to cross.' 'I think so,' said he; 'you are doing nothing.' 'I am not so strong as you,' I answered; 'and we are well as we are.' I stirred the fire, and seized a bundle of straw, which, being too much pressed, did not light well. I shook it over the flame, and the instant after I felt as if I had been seized under the arms, and said to my friend, 'We are rising now, however.' 'Yes, we are rising,' he answered, coming from the interior, where he had been seeing all was right. At this moment, I heard a noise high up in the balloon, which made me fear it had burst. I looked up, and saw nothing; but, as I had my eyes fixed on the machine, I felt a shock, the first I had experienced. The shock was upwards, and I cried out, 'What are you doing—are you dancing?' 'I am not stirring.' 'So much the better,' I said; 'this must be a new current, which will, I hope, take us off the river.' Accordingly, I turned to see where we were, and found myself between the Ecole Militaire and the Invalides, which we had passed by about 400 toises. M. Pilatre said, 'We are in the plain.' 'Yes,' I said, 'we are getting on.' 'Let us set to work,' he replied. I heard a new noise in the machine, which I thought came from the breaking of a cord. I looked in and saw that the southern part was full of round holes, several of them large. I said, 'We must get down.' 'Why?' 'Look!' said I. At the same time, I took my sponge and easily extinguished the fire, which was enlarging such of the holes as I could reach; but on trying if the balloon was fast to the lower circle, I found it easily came off. I repeated to my companion, 'We must descend.' He looked around him and said, 'We are over Paris.' Having looked to the safety of the cords, I said, 'We can cross Paris.' We were now coming near the roofs; we raised the fire, and rose again with great ease. I looked under me and saw the Missions Etrangères, and it seemed as if we were going towards the towers of St. Sulpice, which I could see. Raising ourselves, a current turned us south. I saw on my left a wood, which I thought was the Luxembourg. We passed the Boulevard, and I called out, 'Pied à terre.' We stopped the fire; but the brave Pilatre, who did not lose his self-possession, thought we were coming on mills, and warned me. We alighted at the Butte aux Cailles, between the mill Des Merveilles and the Moulin Vieux. The moment we touched land, I held by the car with my two hands; I felt the balloon press my head lightly. I pushed it off, and leaped out. Turning towards the balloon, which I expected to find full, to my great astonishment it was perfectly empty and flattened."

These are the first aerial voyages that were ever made by human beings that we have any well authenticated proof of. And to these all true historians must point as the first practical and fully successful experiments in navigating the air.

The Montgolfiers were natives of Annonay, and were the sons of a wealthy paper manufacturer, who had retired from business and left it in their hands. From the history that is afforded of them, it appears that they were both attached to the study of mathematical science. But it seems they were not exactly acquainted with the true nature of the substance that caused the ascent of their balloons. They attributed the ascending power of them to a peculiar kind of gas which was emitted by the combustion of chopped straw and wool mixed together. This, however, does not, in the least, detract from the merit of their discovery; and so the learned men of that day thought, for, at the next meeting after their experiment before the Royal Academy of Arts and Sciences of Paris, that eminent body voted Stephen Montgolfier a gold medal, in honor of having made the most important discovery of that period.

That the Montgolfiers did not exactly understand the cause or nature of the material that gave ascensive power to their balloons, is evidenced by their affidavit which communicated the discovery to the Royal Academy. In this, the effect of the balloon's ascension is not attributed to the rarefied state of the air which filled it, but to a peculiar gas evolved by the burning of straw and wool, which they termed "certain materials." It was, for a better name, termed *Montgolfier's gas,* and led even the members of the Academy to believe, for a while, that a new kind of gas, other than hydrogen, and lighter than common air, had been discovered. A certificate to this effect was signed by the Dukes of Polignac and Deguines, the Counts De Polarton and De Vaudreuil, Dr. Franklin, and Messrs. Faujus, Delisle, and Leroy, of the Academy of Arts and Sciences. Dr. Franklin was then in Paris, and had been elected to a membership of that noted institution.

During the latter part of the same year, Dr. Rittenhouse and Mr. Hopkinson made some experiments in the city of Philadelphia, by connecting four balloons together, which were inflated with hydrogen gas. An individual ascended with these to the height of several hundred feet, but, taking alarm, he was induced to cut a hole in one of them, which caused him to descend.

Inflammable air, or hydrogen gas, which is its proper name, was discovered as early as the year 1766. It was even known to exist long before that time by miners of coal. Its fatal effects have often been experienced by that class of men. But its properties were first made known in the year just named, by Mr. Cavendish, as will be seen by reference to the Philosophical Transactions of that period.

Tiberius Cavallo says: Soon after this discovery of Mr. Cavendish, it occurred to the ingenious Dr. Black, of Edinburgh, that a vessel might be made, which, when filled with inflammable air, might ascend into the atmosphere, in consequence of its being altogether lighter than an equal bulk of common air. This idea of the Doctor had been frequently mentioned, but he himself wrote a candid account of it to Dr. James Lind, physician at Windsor; and here follows part of the letter:—

"EDINBURGH, *Nov.* 13th, 1784.

"DEAR SIR: The person who first discovered with exactness the specific gravity of inflammable air was, as far as I know, Mr.

Cavendish. I never heard of any experiments made with that intention, before his appeared in the Philosophical Transactions for the year 1766. It had been my constant practice before, to show, every year, in what manner it burns when pure and unmixed with air, and how it exploded when air is mixed with it before it is fired; but Mr. Cavendish made a variety of such mixtures by rule and measure, and describes in the same paper the manner in which they severally exploded. As soon as I read the above paper, it occurred to me, as an obvious consequence of Mr. Cavendish's discovery, that, if a sufficiently thin and light bladder were filled with inflammable air, the bladder, and the air in it, would necessarily form a mass lighter than the same bulk of atmospheric air, and which would rise in it; this I mentioned to some of my friends, and in my lectures, the next time I had occasion to speak of inflammable air, which was either in the year 1767 or 1768; and, as I thought it would be an amusing experiment for the students, I applied to Dr. Munro, dissector, to prepare for me the allantois of a calf. The allantois was prepared, but not until after some time had passed, and when I was engaged with another part of my course, and did not choose to interrupt the business then going on; so I dropped the experiment for that year, and in the subsequent years I only mentioned the thing as an obvious and self-evident thing, from Mr. Cavendish's discovery; but, finding generally some difficulty in providing an allantois at the proper time, I never made the experiment which I considered as merely amusing. About two months ago, I was informed, by a gentleman in the South of Ireland, that he had tried it, and that it succeeds perfectly well."

These circumstances are related by some writers to show that the principle of raising aerostatic machines had been discovered before the experiment was made by the brothers Montgolfier. Tiberius Cavallo introduces this letter of Dr. Cavendish's in an article wherein he himself claims to be the first person who succeeded in raising balloons. He says, "The possibility of constructing a vessel, which, when filled with inflammable air, would ascend into the atmosphere, had occurred to me when I first began to study the subject of air, and other permanently elastic fluids, which was about eight years ago; but early in the year 1782, I actually attempted to perform this experiment; and the only success I had, was to let soap-balls, filled with inflammable air, ascend by themselves rapidly into the atmosphere; which was perhaps the first sort of inflammable air balloons ever made. I failed in several other attempts of the like nature; and, at last, being tired with the expenses and loss of time, I deferred to some other time the prosecuting of those experiments, and contented myself with giving an account of what I had done to the Royal Society, which was read at a public meeting of the society on the 20th of June, 1782."

Although Mr. Cavallo concedes the right of discovering the aerostatic machine, which first proved successful, to the Montgolfiers, it is but due to his ingenuity and ability in philosophical pursuits to give his ideas in full upon this subject.

The following is a copy of the paper presented to the society by Mr. Cavallo. "It has been commonly believed, that common air would not pervade the pores of paper, such as is used for common printing, or writing; and, that paper is permeable to water, and not air, has been alleged by some persons as an instance tending to prove that some fluids have the property of passing through certain substances, and others have not; although the particles of the former are of a grosser, heavier, or more of a tenacious nature towards each other.

"Admitting, according to the common notion, this impermeability of paper to common air, and presuming that it was impervious to other permanently elastic fluids also, I determined to make use of paper for an experiment, which, though repeatedly attempted with other substances, had never succeeded. The experiment was, to construct a vessel, or a sort of bag, which, when inflated with inflammable air, might be lighter than an equal bulk of common air, and consequently ascend, like smoke, into the atmosphere; it being well known that inflammable air is specifically lighter than common air.

"The weight of inflammable air, the mean weight of atmospheric air, and the weight of substances of which the vessels are to be formed, being ascertained, it is easy then to determine, by calculation, the dimensions of a vessel which, when filled with inflammable air, might be lighter than an equal bulk of atmospheric air. In this manner, and for the above-mentioned purpose, I tried bladders, the thinnest and largest that could be procured. Some of them were cleaned with great care, removing from them all the superfluous membranes and matter that could be possibly scraped off; but, notwithstanding all these precautions, the lightest and largest of these bladders being gauged, and the requisite calculations being made, it was found that, when filled with inflammable air, it would be at least ten grains heavier than an equal bulk of common air, and consequently it would descend, instead of ascending, in that element. Some swimming bladders of fishes were also found too heavy for the experiment; nor could I even succeed in making durable light balls by blowing inflammable air into a thick solution of gums, thick varnishes, and oil paint. In short, soap balls, inflated with inflammable air, were the only things of this sort that would ascend into the atmosphere; but as they were very brittle, and altogether untractable, they do not seem applicable to any philosophical purpose."

Thus, it is seen that, in the progress of over 2000 years, this science was gradually built up. Each succeeding generation adding to it the ideas and recommendations of its most ingenious artists. As an obvious truth, it naturally inspired the scientific of all ages to explore its feasibility to human convenience. As an acknowledged science, and practicable art, it is yet destined to open to the civilized world a grand and expansive field of happiness. Those who contributed to its discovery deserve the attention of the historian; because their perseverance, and indefatigable efforts, devoted to its development, are calculated to keep alive the energy of those who shall succeed them in endeavoring to improve its usefulness.

Although Mr. Gallien, in his book published in 1755, asserts in theory the very thing that was practically demonstrated by the Montgolfiers in 1782, and Tiberius Cavallo more than theorized the subject by inflating soap bubbles, still it required much more than all these intimations and incomplete experiments to demonstrate to the world that the atmosphere was really navigable to human beings. Tiberius Cavallo did in reality approach nearer to a final discovery than any of his predecessors; but from his own words he makes it appear that little, beyond the partial success of his soap-bubbles, was attained in his investigations. The necessary stimulus—realization of the theory, such as the experiment at Annonay—yet wanting, would have left the subject to slumber with the mysteries unrevealed, had it depended on his experiment alone, at least for a time to come.

The Royal Academy had the same inducements, in a merely philosophical point of view, to institute experiments to the ascent of bodies in the air, upon Cavallo's communications and those of Dr. Black, that they had on the information of the Montgolfiers' discovery. In short, the merit of any discovery properly belongs to the actual inventor, to him who first realizes the idea by putting it in practical operation, just as the Montgolfiers did with their balloons.

After the decisive experiment had been made by the aerial voyage of M. Pilatre de Rozier and the Marquis d'Arlandes, over the city of Paris, and in sight of all the people of that modern Athens, it naturally gave an impulse to the subject that operated more favorably on its progress and improvement than any mere theory or simple experiments could have given it for ages. It was the *experimentum crucis* of aeronautic science. The news of it spread like wildfire through every civilized nation on the earth. America not behind the rest, and with its Rittenhouse and Hopkinson distinguished our nation, even on that subject, for the genius and boldness of its people.

Paris did not long remain alone the theatre of aeronautic experiments. In the following year, a balloon of most extraordinary size was constructed in the city of Lyons. It was 130 feet high, and 105 feet in diameter. It lifted up over eighteen tons when the air was highly rarefied in it. On the 19th of January, 1784, an experiment was made with it. After the preliminary arrangements of preparing a fire-place over which to inflate it, and a frame on which to lay it, the inflation was completed in the short space of seventeen minutes. Seven aeronauts then took their station on and around the gallery of the balloon. Everything being now adjusted so as to keep this huge machine in proper trim, the rarefaction of the air within it being at such a pitch as to give it a tremendous ascending power, it was thus suffered to waft itself and passengers into the serene atmosphere above.

The effect of the ascension, as given by the accounts at the time, was astonishing in the extreme. The intense curiosity of the vast concourse of people present seemed at first completely paralyzed by the grandeur of its ascent; but, soon after, they broke out in the most intense and tumultuous shoutings. In seventeen minutes, the balloon rose 3500 feet high, which was ascertained by instruments expressly provided for the occasion.

Unfortunately for this magnificent machine, it was made of material of too frail a quality for so large a balloon, which caused it to give way on one side when it was at the greatest height, making a rent of at least fifty feet. This caused the inclosed air to cool very suddenly, which brought the whole concern down with considerable rapidity. The passengers, however, all landed safely, having received not even the slightest injury from the accident.

In the month of February of the same year, a balloon was constructed at Milan. This was only sixty-eight feet in diameter. Three Italian gentlemen ascended with it, and made a very interesting voyage. They remained in the atmosphere for a considerable length of time, and managed to lower and raise themselves at pleasure by regulating the fire by which they kept up the rarefaction of the air in the balloon. They were eminently successful in the whole adventure, which inspired a degree of confidence in that quarter, in regard to the management and safety of aerial traveling, that acquired for the subject a fresh spirit of improvement.

Having thus followed out the most important experiments and adventures made with fire balloons on the Montgolfierian principle, we will now go back a year or two to investigate the introduction and experiments of the hydrogen balloon.

CHAPTER IV.

Introduction of the hydrogen balloon under the auspices of members of the Academy of Arts and Sciences—The inflation—Torch-light procession with it to the Camp of Mars—Successful termination.

After the subject had been fairly tested in the presence of all classes of people, and the news clearly brought before the learned institutions of the world, it naturally inspired the members of the French Academy to take up anew the experiments of Cavallo, and the suggestions of Dr. Black. The certificate, presented to the Academy by the States of Vivarais, stated that the Montgolfiers' balloon was filled with a gas half as heavy as common air. Now, as it was known at that time that hydrogen gas was not more than one-eighth or one-tenth as heavy as common air, they supposed that the Montgolfiers had discovered a new kind of gas. From the large quantities used in their experiments, and the very short time it took them to generate it, it was evident that it could not be hydrogen. This, together with the great difference of specific gravity of the two gases, brought them to the conclusion to make an experiment with the hydrogen.

When we consider the many and fruitless attempts that had been made by a number of ingenious men, in various parts of Europe, to contrive a machine or vessel that would be impervious to hydrogen gas, and at the same time light enough to ascend when filled with it, we can duly appreciate the result of this first experiment. A subscription to defray the expenses incident to the necessary arrangements was opened by M. Faujus De Saint Fond. Persons of all classes and ranks, on being apprised of the design, eagerly sought an opportunity to put down their names. With an avidity of feeling adequate to the interest already inspired to promote the object, the money necessary to accomplish a full and complete trial was immediately subscribed. This preliminary disposition of the people, in regard to furthering an object which promised to be of vast importance to the civilized world, reflects honor on the French nation for their liberality of spirit, and desire to promote scientific objects.

The Messrs. Roberts (brothers) were appointed to construct the machine, and M. Charles, professor of experimental philosophy, was appointed to superintend the whole affair. Although the reader will learn that, under these preliminary arrangements, they surmounted every obstacle, and accomplished the object of their design, still they had nothing more to be governed by, than was known to Gallien, Dr. Black, Cavallo, and others, who preceded them. It might be inquired, how could they be more successful now than then, if they had nothing more obvious to direct them in the present attempt? Why, because a new life had been given to the inventive genius. The experiment of the Montgolfiers had really proved that aerostatic machines could be made and raised. This fired the ingenuity of these men. They had not the question to settle, when their machine was made, whether it would rise. It had only to be made and filled with a gas (hydrogen), which they knew to be lighter, and consequently better adapted to the object in view, than that of their predecessors. To make a bag that would retain the gas, was the problem to be solved. And for the accomplishment of this, as it was done, they deserve great honor. Of such a nature must be the stimulus that is yet to give the art a valuable feature! We know that the air is navigable! We know that it is in the elements of philosophy that balloons can be made to travel in any direction! And, like the committee appointed to perfect the firststep, we must apply ourselves with zeal and energy to promote the second.

They constructed a silken bag from lutestring silk, about thirteen feet in diameter, and of a globular shape. The next step was to make this bag or balloon impervious to the gas. To effect this, it was covered with a varnish composed of gum elastic, dissolved in spirits of turpentine. The balloon had but one aperture, like the neck of a bottle, into which was fastened a stopcock, for the convenience of introducing and stopping off the gas. The whole machine, when completed, weighed twenty-five pounds.

On the 23d of August, 1783, the balloon being completed, the next to be done was to make arrangements for the inflation, and the appointment of a day on which to make the final experiment. These were matters not to be regarded slightly at that day. Members of the most celebrated institution of the age had ventured their talents and ingenuity upon the result. To generate so large a quantity of hydrogen gas at that period, had many obstacles in its way. And on this account a full description of the manner in which it was conducted should be here given. The 27th of the month was the day appointed for the grand exhibition. But, in order to have ample time for alterations, and refixing any part of the apparatus that might not answer the purpose, they commenced the inflation on the 23d. The balloon was suspended from a rope, which was fastened at both ends, to poles planted some distance apart for that purpose. The top of the balloon had a sort of button worked in it, to which was fastened the rope, by which it was hanging freely over the inflating apparatus. This apparatus consisted of a series of trays, somewhat resembling a case of drawers, each drawer being lined with sheet lead, and all of them communicating to a common main pipe, from which proceeded a hose, or tube, made of the same material as that of the balloon. This hose communicated to the stopcock of the balloon, which made the arrangement of communication complete. The materials for generating the hydrogen gas were then placed in these cases, and the process of inflation was carried on for several hours, with but very poor success. More gas was wasted than entered the balloon. After having thus labored, with little success, until two o'clock in the afternoon, they concluded to remove this apparatus and substitute another. Accordingly, they next tried a common cask, which was set up on one of its ends; in the upper end were bored two holes, one of which corresponded to the tube through which the gas was to be conducted into the balloon, the other hole was intended for the introduction of the iron filings, and the oil of vitriol. The process of inflation was next commenced with this new contrivance, which soon promised better success than the former. It will be observed that they had not, in this apparatus, the condensing tube filled with water for the gas to pass through, as we have in the present mode of inflating balloons. This rendered the inflation very dangerous to the safety of the balloon, from acid vapor that might pass into it, every time the cask required replenishing with fresh materials, which it did very frequently. To obviate this difficulty in some degree, the stopcock in the neck of the balloon answered a good purpose, as, on the introduction of new materials, it could be closed to prevent the acid fumes from entering the balloon during this part of the process. Although this new arrangement answered the purpose seemingly well at first, it was discovered, after being used awhile, to present many obstacles to a successful result. After the operation had been carried on for several hours, the materials became so much heated that a great quantity of hot vapor would pass into the balloon along with the gas. To prevent the balloon from being injured by the heat, they kept a constant stream of water pumping against it. This also answered to condense the hot vapor into water. To discharge the water from it, it was frequently necessary to detach the balloon from the inflating apparatus to suffer the water to escape.

After working in this way until nine o'clock at night, they got the balloon about one-third filled; and in this state it was left until the next morning, the inflation being also discontinued during the night.

The next morning, at the break of day, the operators returned to resume their labors. On arriving at the place, they were exceedingly surprised to find the balloon completely distended, although it had been but partly filled the day before. On examining the machine, they discovered that the stopcock in the neck of the balloon had been left open, which suffered the common air to enter, and with the gas already in it, to make it completely full. This, however, did not discourage the experimenters. They immediately expelled all the air from the balloon, and commenced their operations anew, with apparently more energy and hope than the previous day. They labored assiduously until about six o'clock in the evening, when, to their great satisfaction, they saw the balloon giving evident signs of buoyancy; and at seven o'clock they found it to exert considerable effort against the rope above it, to which it had been suspended. Everything was now properly secured against all impending danger, and the operations discontinued until the next day.

The following day, the 25th, they resumed their labors early in the morning. They did not, on this morning, as the one previous, find anything wrong, or calculated to mar their future progress. A fresh supply of gas was introduced, and, at six o'clock in the morning, the balloon was found to be capable of lifting up twenty-one pounds. The generation of gas was again discontinued, and at nine o'clock in the evening, it was found to have a lifting power of eighteen pounds, having lost three pounds of levity during the day. This was attributed to the needle holes, which were not properly filled up with varnish, and through which, it was presumed, the gas had leaked. It was again secured for the night, and the operators retired from their work.

On the following morning, being the 26th, the balloon was found to have lost a gradual proportion of gas and levity. The apparatus was again replenished with the proper materials, and a further quantity of gas was worked into the balloon. This was continued until eight o'clock in the morning, when it was again detached from the machinery. Having now a strong ascending power, it was secured by cords, by which it was suffered to rise to the height of more than a hundred feet, when it was drawn down again. This, as might naturally be supposed, brought together a great number of people. From these partial flights of letting it up, and hauling it down again, the assemblage became so great, that it was found necessary to secure it to its place, where it had been inflated, and a guard of soldiers placed around it to prevent the crowd from pressing too closely on it, and causing it some injury. Such was their curiosity, that they had already broken through the prescribed limits, and nothing short of a strong guard was found capable of insuring its safety.

The spot where the operations had been carried on was near the place of Victories, and the place appointed for the ascension of the balloon was the Camp of Mars. The distance between these two places is about two miles. In order to avoid, as much as possible, the difficulty of conveying the balloon from the former to the latter place, amidst so vast a concourse of people as might be anticipated would be there, it was concluded to move it the next morning before daylight.

Accordingly, on the following morning, it being the 27th, at an early hour, preparations were made for its removal to the Camp of Mars. It was secured to a cart, and notwithstanding everything was in readiness to proceed before the break of day, an immense concourse of people had already assembled to escort the nocturnal traveler. Torches, flambeaux, musical instruments, guns, and everything that the lively imagination of the people could suggest, were brought into requisition, to render the procession grand and animating.

The Camp of Mars was lined in every direction with anxious spectators. Every house top, avenue, and window, along the route, was filled with human beings; and, as the strange and novel machine passed along, in the midst of a strong military guard of horse and foot, supporting itself in the air, reflecting the light of the numerous torches, giving it the appearance, at a distance, of a bright star, the air fairly rung with the shouts of the assembled and pleased multitude. Having arrived at its place of destination, and the proper arrangements being made to secure it from the pressure of the dense throng that already had assembled, it was again secured to the inflating apparatus, which had also been brought hither. A fresh supply of gas was introduced to make up the loss which the balloon sustained during the night. It also gave the people an opportunity of seeing how the inflation was conducted. Thus the day passed on, with constantly increasing accessions to the great multitude already present. At length, the discharge of artillery, at five o'clock in the afternoon, announced the signal for the experiment. The balloon was released from its moorings, and rose before the eyes of some hundred thousands of astonished spectators, amidst a copious shower of rain. Its ascent was extremely rapid, and in the short space of two minutes it attained a height of 3123 feet. This was ascertained by observations made with instruments expressly provided for that purpose. Above this elevation, the balloon was lost in a dark cloud. This was signalized by another discharge of cannon. Soon after, it re-appeared for a moment, but was finally hidden behind the clouds. During the time of its visible flight, the very air was made to reverberate with shouts and demonstrations of satisfaction—a heavy shower of rain to the contrary notwithstanding. After it had remained in the atmosphere for three quarters of an hour, it descended in a field near Gonesse, a village about fifteen miles distant from the Camp of Mars. The balloon was immediately discovered and secured by some peasants, who were working in a field near its place of descent.

The manifestations of joy, and the satisfactory exclamations of the vast multitude of people that had assembled on this occasion, are most graphically described by some of the journals of that day. Although the ascent of an aerostatic machine was not of itself any longer calculated to inspire such a lively interest, this was the test of a new principle, which, if successful, was calculated to give it a new impulse, on account of its greater feasibility than the rarefied air principle.

The liberality and energy that characterized this experiment, the obstacles that were surmounted in an unexplored and critical science, the devotion and interest of the people manifested towards a successful result, reflect honor on its projectors. It has marked an epoch in the history of the world, that will increase in interest as long as the arts and sciences shall hold an equal pace with its progressive movement.

CHAPTER V.

Infatuated conceptions of aerial voyages.

Now that a new door had been opened, through which the genius of man could take a view into the future destinies of a new science, it inspired a feeling which had a tendency to overrate the value of the discovery. An overheated zeal, fostered by an ambitious desire to explore the grand mysteries of the Creator, necessarily brought about a reaction that was calculated to do more harm than good, in improving the new science. The infatuation of men carried their minds beyond the legitimate sphere of their operations. The exploration of their own world and its mysteries was no longer sufficient to give interest adequate to their expectations and attainments. Greater and more magnificent projects dazzled their bewildered minds. The grand ultimatum of human aspirations had been solved in the problem of aerostation. Man could now build himself a "castle in the air." He was no longer subservient to the laws of gravitation, which bound him to the land, and the water. He felt that more than Bishop Wilkins' saying had been realized, when he said, "It will be as common for a man hereafter to call for his wings, when about to make a journey, as it is now to call for his boots and spurs." To make a long journey, or to circumnavigate the earth, fell into insignificance, compared with the projects and ideas that were conceived. The earth appeared now related to man, as the haycock in the field was to the lark, when he mounted its top with expanded wings, to launch himself into the immensity of space. Voyages to the moon and neighboring planets haunted the imagination of more than weak minds. The binding cord of gravitation had been severed, and there was no restraint above. No one could define the limit of operations to this new and important discovery. The traditions of flying oracles, which were handed down by profane and sacred history, were now looked upon as realities which had been discovered and lost to human ingenuity. All the glories of the past, the present, and the future, seemed to be resolved in the re-discovery of this grand art. The fanciful dreams and midnight visions of the Parisians were not the only disturbed slumbers of that period. All civilized Europe had its genius startled at the news of the academical experiment. All eyes were turned to Paris, as the point of embarkation for other worlds. It stood now as a depot in the solar system. Even the skeptical in religion began to think that a more exalted destiny awaited man, than to sink in the earth and sleep forever in its mouldering ashes.

These overwrought imaginings and premature speculations subsided as the sober and considerate experiments advanced. Notwithstanding the public mind resumed a natural equilibrium in regard to aerial navigation, the scientific and ingenious were not backward in promoting its utility. The first adventurers were not disparaged in their pursuits by discovering the immutable laws that confine all things to their legitimate sphere. Although the idea of immigrating to foreign worlds soon vanished from the minds of men, there still existed and progressed a perseverance to render the discovery useful to terrestrial purposes, that conferred an honor on that age.

This will be shown in the historical details that will be given of the experiments that followed the discovery of the hydrogen balloon. Although the experiment which was instituted by the Academy of Arts and Sciences of Paris, to test the use of hydrogen gas instead of the dangerous mode of keeping up a rarefaction of air by the use of fire, proved eminently successful, it was still contended by the friends of Montgolfiers' plan that the heated air principle was the best. And it will be observed that the advocates of the Montgolfierian plan gave strong reasons to sustain their position. They succeeded in many of their experiments far beyond what the best contrived rarefied air plans warranted. Aerial voyages of great interest and success were made with extraordinarily large rarefied air balloons, in various parts of France.

The same perseverance and intrepidity that prevailed in the promotion of aerial navigation about the time of the discovery of air-balloons could not fail, if revived at the present time, to give it an impetus in the scale of improvement, that would, ere long, realize all that was, upon its first discovery, anticipated by its sober-minded advocates. But, like every other subject, it must have its time. Time alone will overcome the doubts and opposition of those who denounce it through the want of a proper understanding of its real merits.

CHAPTER VI.

First aerial voyage with a hydrogen balloon—Experiments to regulate its direction, and rising and falling—Blanchard's voyage across the sea—Compound aerostat and fatal result—Testu's remarkable voyage.

The successful experiment of the first hydrogen balloon encouraged anew the desire for aerial voyages. M. Charles and the two Messrs. Roberts resolved to undertake an aerial excursion with a balloon filled with hydrogen gas. One was accordingly prepared by the Messrs. Roberts, of varnished silk. It was of a spherical form, twenty-seven feet in diameter, and had a car suspended from it for the accommodation of the adventurers. To prevent any danger from the expansion of the gas under a diminished pressure of the atmosphere in the upper regions, the balloon was furnished with a valve, formed in such a manner as to permit the free discharge of gas when occasion required. Thus, on the 17th of December, 1783, M. Charles, and one of the Roberts, having previously ascertained the direction of the wind by launching a small balloon, ascended from Paris to the height of 6000 feet; and, after a voyage of an hour and three-quarters, descended at a distance of twenty-seven miles from the place of their departure. After their descent, M. Roberts got out of the car, which lightened the vessel about 130 pounds, which enabled M. Charles to reascend; and in twenty minutes he attained an elevation of 9000 feet above the surface of the earth. At this immense height, he says, all terrestrial objects totally disappeared from his view. The thermometer stood at 47 degrees when he left the earth, but in the space of ten minutes it fell to 21 degrees. The effects which so rapid a change of situation produced upon him were violent in the extreme; he was benumbed with cold, and felt a severe pain in his right ear and jaw. The balloon passed through different currents of air, and in the higher regions the expansion of the gas was so powerful, that M. Charles was obliged to allow part of it to escape in order to prevent the bursting of the balloon. After having risen to the height of 10,500 feet, he came down about a league from the place where he left his companion out of the car. The balloon, including the two aeronauts, thermometer, barometer, and ballast, weighed 640 pounds, and the hydrogen gas was found, on calculation, to be about five and one-quarter times lighter than common air.

Jean Pierre Blanchard, an ingenious Frenchman, who had spent a great deal of time in trying to perfect a mechanical contrivance by which he might be enabled to fly, was the next to construct a balloon upon the hydrogen gas plan. This was also twenty-seven feet in diameter. He ascended from Paris on the 2d of March, 1784, accompanied by a Benedictine friar. After rising fifteen feet, the balloon was precipitated to the ground with a violent shock, upon which, the friar, apprehensive of his safety, was induced to abandon his seat. M. Blanchard then ascended alone, and attained a height of 9600 feet. He met with various currents of air. He suffered from extreme cold, and became oppressed with drowsiness, and finally descended, after a voyage of an hour and a quarter. In order to direct his course, he used, on this occasion, an apparatus consisting of a rudder and two wings, which were attached to his car, but found that it exerted little or no influence over the balloon, either in this or in subsequent voyages.

In April, 1784, MM. Morveau and Bertrand adopted a similar expedient, which they found to operate very sensibly on the direction of their balloon. They rose about 13,000 feet high, where they enjoyed one of the most sublime and magnificent prospects that the imagination could conceive. The mass of clouds that floated in silent disorder through the regions below them, presented the appearance of a serene and boundless ocean, while a beautiful parhelion of concentric circles, that began to form as the sun went down, heightened the grandeur of the scene. In the month of June following, M. de Morveau undertook another voyage, which, as well as the former, commenced at Dijon. His balloon was twenty-five feet in diameter, and made of varnished taffeta.

A similar device for regulating the course of the balloon was resorted to by the Messrs. Roberts, who had before ascended together. Their former balloon was converted into an oblong spheroid, forty-six feet by twenty-seven, the longer axis being parallel to the horizon, and the car, which was seventeen feet long, had five wings or oars disposed around it, for the purpose of steering. The Messrs. Roberts, and M. Collin Hullin, upon entering the car of this machine, threw out twenty-four pounds of ballast, which produced a gentle ascent. The current of air between the altitudes of 600 and 4200 feet was uniform. On arriving at the height of 14,000 feet, they encountered some stormy clouds, which they endeavored to avoid, by alternately ascending and descending. In three hours from their ascent, they heard two peals of thunder, when the thermometer fell from seventy-seven to fifty-nine degrees. Finding themselves, soon afterwards, becalmed, they had recourse to their oars, by the exertion of which, their balloon, in thirty-five minutes, described an elliptical segment, whose shortest diameter was 6000 feet. After traveling 150 miles, in the space of six hours and a half, they descended in safety.

The Messrs. Roberts, accompanied by the Duke of Orleans, and a fourth person, ascended in July, 1784, in a balloon different in its structure from any that had hitherto been tried. On all former occasions, aeronauts had found the method of effecting a descent by a discharge of gas, attended with inconvenience, and to obviate this difficulty, the Messrs. Roberts had suspended a small balloon within the large one. This interior balloon was to be filled with common air, by means of bellows attached to it by tubes, whenever they wished to descend, it being justly supposed, that the addition of common air would increase the weight, as its diminution would, on the other hand, lighten the balloon. This expedient, however, though promising in theory, did not answer in practice. In the space of three minutes, they rose to a height where not an object was to be seen but the clouds that surrounded them. The balloon, no longer obeying their management, was tossed, with the most violent agitation, as if from one whirlwind to another. The cords, by which the interior balloon was suspended, giving way, it fell down in such a position as completely to close up the aperture which communicated between the large balloon and the car. A sudden gust of wind next drove them beyond the region of the storm; but the expansion of the hydrogen within the vessel increasing, they dreaded the bursting of the balloon, and, being unable to remove the small one, which now obstructed the aperture, they continued to ascend. It finally gave way in two places, and, notwithstanding the imminent danger to which they were exposed, from the rapidity of its descent caused by this accident, they all landed without being hurt.

Though several experiments on the ascensive power of balloons had been made in England, during the course of the year after their discovery, the first aerial voyage, which was undertaken by

Vincent Lunardi, an Italian, did not take place till September, 1784. His balloon was thirty-three feet in diameter, and shaped like a pear. It was made of oiled silk, with alternate stripes of blue and red, having the car suspended from a hoop below the balloon, by forty-five cords.

FIRST AERIAL VOYAGE ACROSS THE SEA.

The most remarkable aerial voyage that was made soon after the discovery of aerostatic machinery, was accomplished by M. Blanchard, in company with Dr. Jeffries, an American physician, who was at the time residing in England. On the 7th of January, 1785, in a clear frosty day, the balloon was launched from the cliff of Dover, and, after a somewhat perilous adventure, they crossed the Channel in something less than three hours. The balloon, after its release, rose slowly and majestically in the air; they passed over several ships, and enjoyed a grand prospect of the numerous objects below them. They soon, however, found themselves beginning to descend, which put them to the necessity of throwing over half their ballast, when they were about one-third way across the Channel. When they got about half way across, they found themselves descending again, upon which, they threw over the balance of their sand; also some books they had with them. All this failed to overcome the gravitating power of the balloon. They next commenced throwing overboard their apparatus—cords—grapples, and bottles. An empty bottle seemed to emit smoke as it descended, and, when it struck the water, the shock of the concussion was sensibly felt by the aeronauts. Still, their machine continued to descend, when they next betook themselves to throwing off their clothing; but, having now nearly reached the French coast, the balloon began to ascend again, and rose to a considerable height, without compelling them to dispense with much of their apparel. They passed over the highlands between Cape Blanc and Calais, and landed near the edge of the forest of Guiennes, not far beyond Calais. The magistrates of the town treated the aerial travelers with the utmost kindness and hospitality. The King of France made M. Blanchard a present of 12,000 livres, as a token of appreciation of the aeronaut's perseverance and skill, in the newly-discovered art.

Several hundred ascensions had now already been made, and not a single fatal accident had yet taken place; but we are now compelled to record one which proved most disastrous to its projectors, and when we fairly estimate its design, it seems as though it could hardly have terminated otherwise. Pilatre de Rozier and

M. Romain were anxious to return the compliment of M. Blanchard and Dr. Jeffries, by crossing over the Channel from France to England. For the purpose of avoiding the difficulty which attended Blanchard's balloon in keeping her up, they constructed a compound balloon. This was arranged by suspending a fire balloon underneath the hydrogen balloon. The fire balloon was intended to regulate the rising and falling of the whole machine. The hydrogen balloon was of a globular shape, forty feet in diameter; the other was about ten feet in diameter. After various delays, occasioned by adverse winds, he, in company with M. Romain, set out from Boulogne, on the 15th of June, 1785. Scarcely a quarter of an hour had elapsed, when, at the height of about 3000 feet, the whole apparatus was discovered to be on fire. Its scattered fragments, with the unfortunate bodies of the aeronauts, fell to the ground near the sea shore, about four miles from Boulogne. They were instantly killed by the tremendous crash, and their bodies were of course awfully mangled.

TESTU'S REMARKABLE VOYAGE.

"On the 18th of June, 1785, M. Testu ascended from Paris. His balloon was twenty-nine feet in diameter, constructed by himself, of glazed tiffany, furnished with auxiliary wings, and filled, as had now become the fashion, with hydrogen gas. It had been much injured by wind and rain during the night before its ascension; but, having undergone a slight repair, it was finally launched, with its conductor, at four o'clock in the afternoon. The barometer then stood 29.68 inches, and the thermometer as high as eighty-four degrees, though the day was cloudy and threatened rain. The balloon had at first been filled only five-sixths; but it gradually swelled as it became drier and warmer, and acquired its utmost distension at the height of 2800 feet. But to avoid the waste of gas or the rupture of the balloon, the navigator calculated to descend by the reaction of his wings. Though this force had little efficacy, yet at half-past five o'clock he softly alighted in a corn-field in the plain of Montmorency. Without leaving the car, he began to collect a few stones for ballast, when he was surrounded by the proprietor of the corn and a troop of peasants, who insisted on being indemnified for the damage occasioned by his idle and curious visitors. Anxious now to disengage himself, he persuaded them that, his wings being broken, he was wholly at their mercy. They seized the stay of the balloon, which floated at some height, and dragged their prisoner through the air in a sort of triumph towards the village. But M. Testu, finding that the loss of his wings, his cloak, and some other articles, had considerably lightened the machine, suddenly cut the cord, and took an abrupt leave of the clamorous and mortified peasants. He rose to the region of the clouds, where he observed small frozen particles floating in the atmosphere. He heard thunder rolling beneath his feet, and as the coolness of the evening advanced, the buoyant power of his vessel diminished, and at three quarters after six o'clock, he approached the ground with his car near the Abbey of Royaumont. There he threw out some ballast, and in the space of twelve minutes rose to a height of 2400 feet, where the thermometer stood only at sixty-six degrees. He now heard the blast of a horn, and descried some huntsmen below in full chase. Curious to witness the sport, he pulled the valve and descended at eight o'clock, between Etouen and Varville, when, rejecting his oars, he set himself to gather some ballast. While he was thus occupied, the hunters galloped up to him. He then mounted a third time, and passed through a dense body of clouds, in which thunder followed lightning in quick succession.

> 'With fresh alacrity and force renewed,
> Springs upward, like a pyramid of fire,
> Into the wild expanse, and through the shock
> Of fighting elements, on all sides round
> Environed wins his way.'

"The thermometer fell to twenty-one, but afterwards regained its former point of sixty-six degrees, when the balloon had reached an altitude of 3000 feet. In this region, the voyager sailed till half-past nine o'clock, at which time he observed from his 'watch-tower in the sky' the final setting of the sun. He was now quickly involved in darkness, and enveloped in the thickest mass of thunder clouds. The lightnings flashed on all sides, and the loud claps were incessant. The thermometer, seen by the help of a phosphoric light with which he had provided himself, stood at twenty-one degrees, and snow and sleet fell copiously around him. In this most tremendous situation, the intrepid adventurer remained the space of three hours, the time during which the storm lasted. The balloon was affected by a sort of undulating motion upwards and downwards, owing, he thought, to the electrical action of the clouds.* The lightning appeared excessively vivid; but the thunder was sharp and loud, preceded by a sort of crackling noise. A calm at last succeeding, he had the pleasure to see the stars, and embraced this opportunity to take some necessary refreshments. At half past two o'clock, the day broke in; but his ballast being nearly gone, he finally descended a quarter before four o'clock, near the village of Campremi, about sixty-three miles from Paris."

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* It is caused by the uprising current of air which always prevails in thunder storms. This would drive his balloon up to the top of the clouds, from whence it would fall into the vortex below again.

CHAPTER VII.

Invention of the parachute—Experiments with it.

As the *parachute* properly belongs to the subject of aeronautics, we must not defer giving its earliest introduction and use in the practice of aerial navigation. As the chief danger in the early practice of balloon voyages consisted in accidental and rapid descents, the parachute was introduced to countervail this danger, and which would also enable the aerial voyager, in case of alarm, to desert his balloon in mid-air, and drop, without sustaining injury, to the ground. The French language, though not very copious, has yet supplied this convenient term, signifying *a guard for falling*, as it has likewise furnished the words of analogous composition, *parapluie*, *paravent;* and *parasol*, to denote a sun-screen. The parachute very much resembles the ordinary umbrella in shape, but is much larger. The umbrella itself, requiring such strength to bear it up against a moderate wind, might naturally have suggested the application of the same principle to break the fall of a body coming from a great height. To effect this, nothing was required but to present a surface having dimensions sufficient to experience from the air a resistance equal to the weight of descent, in moving through the fluid with a velocity not exceeding that of the shock which a person can sustain without danger of injury. Accordingly, in the east, where the umbrella, or rather the parasol, has been from the remotest ages in familiar use, this implement appears to be occasionally employed by vaulters, for enabling them to jump safely from great heights. Father Loubere, in his curious account of Siam, relates that a person, famous in that remote country for his dexterity, was accustomed to divert exceedingly the king and the royal court by the prodigious leaps which he took, having two umbrellas with long slender handles fastened to his girdle. He generally alighted on the ground, but was sometimes carried by the force of the wind against trees and houses, and not unfrequently into the river. Not a great many years ago, the umbrella was, at least on one occasion, employed in Europe with similar views, as well as in our own country. In the campaign of 1793, a French general, named Bournonville, having been sent by the National Convention, with four more commissioners, to treat with the Prince of Saxe-Coburg, was, contrary to the faith or courtesy heretofore preserved in the fiercest wars that have raged in civilized nations, detained a prisoner with his companions, and sent to the fortress of Olmutz, where he suffered a rigorous confinement. In this cruel situation, he made a desperate attempt to regain his liberty. Having provided himself with an umbrella, he jumped from a window forty feet high; but, being a very heavy man, this screen proved insufficient to let him down safely. He struck against an opposite wall, fell into the ditch, and broke his leg, and was carried in this condition back again to his dungeon.

Blanchard was the first person who ever constructed a parachute for the purpose of using it with a balloon, in cases of accident while aloft. During an excursion which he took from Lisle, about the end of August, 1785, during which, he traversed without halting, a distance not less than 300 miles, he let down a parachute with a basket fastened to it containing a dog, from a great height, which fell gently through the air, and let the animal down to the ground unhurt. Since that period, the practice and management of the parachute have been carried much farther by other aeronauts, and particularly by M. Garnerin, who has dared repeatedly to descend from the region of the clouds with that very slender machine. This ingenious and spirited Frenchman visited London during the short peace of 1802, and made two fine ascents with his balloon, in the second of which he let himself fall from an amazing elevation with a parachute. This consisted of thirty-two gores of white canvass formed into a hemispherical shape of twenty-three feet in diameter, at the top of which was a round piece of wood ten inches in diameter, and having a hole in its centre, admitting short pieces of tape to fasten it to the several gores of the canvass. About four feet and a half below the top, a wooden hoop of eight feet diameter was attached by a string from each seam; so that, when the balloon rose, the parachute hung like a curtain from this hoop. Below it was suspended a cylindrical basket covered with canvass, about four feet high, and two and a quarter wide. In this basket the aeronaut, dressed in a close jacket and a pair of trowsers, placed himself, and rose majestically from an inclosure near North Audley Street, at six o'clock in the evening of the 2d of September. After hovering seven or eight minutes in the upper region of the atmosphere, he meditated a descent in his parachute. Well might he be supposed to linger there in dread suspense, and to

"—————————— look awhile
Pondering his voyage; for no narrow frith
He had to cross * * * * *
He views the breadth, and, without longer pause,
Downright into the world's first region throws
His flight precipitant, and winds with ease,
Through the pure marble air, his oblique way."

He cut the cord by which his parachute was attached to the net of the balloon; it instantly expanded, and for some seconds it descended with an accelerating velocity, till it became tossed extremely, and took such wide oscillations, that the basket or car was at times thrown almost level or horizontal with the parachute. Borne along at the same time by the influence of the wind, the parachute passed over Marylebone and Somerstown, and almost grazed the houses of St. Pancras. At last it fortunately struck the ground in a neighboring field; but the shock was so violent as to throw poor Garnerin on his face, by which accident he received some cuts, and bled considerably. He seemed to be much agitated, and trembled exceedingly at the moment he was released from the car. One of the stays of the parachute had chanced to give way, which untoward circumstance deranged the apparatus, disturbed its proper balance, and threatened the adventurer, during the whole of his descent, with immediate destruction. At the moment of separating the parachute, the balloon took a rapid ascending motion, and was found, next day, twelve miles distant from the place of departure.

From the principles before explained, we may easily determine the descent of a parachute, when, with its attached load, it is abandoned in the air. It must, from the continued action of gravity, proceed at first with an accelerated motion, till its increasing velocity comes to oppose a resistance equal to the force of attraction, or to the combined weight of the whole apparatus. After this counterpoise has taken place, there exists no longer any cause of acceleration; the parachute should descend uniformly with its acquired rapidity. This perfect equilibrium will not, however, be attained at once. The accumulation of swiftness, produced by the increasing operation of gravity, is not immediately restrained by the corresponding increased resistance of the atmosphere. The motion of a parachute must hence, for some short time, be subject to a sort of interior oscillation, alternately accelerating and retarding. It first shoots beyond the terminal velocity, and then, suffering greater resistance, it relaxes, and contracts within the just limits. This unequal and undulating progress which a parachute exhibits subsequently to the commencement of its fall, is calculated to excite disproportionate alarms of insecurity and danger. The terminal velocity of a parachute, or the uniform motion to which its velocity tends, would, according to theory, be equal, if its surface were flat, to the velocity that a heavy body must acquire in falling through the altitude of a column of air incumbent on that surface, and having, under the usual circumstances, the same weight as the whole apparatus. But we have already seen that a cylinder of air, one foot in diameter and height, weighs only, in ordinary cases, the seventeenth part of a pound avoirdupois. Wherefore, if the square of the diameter of a parachute be divided by seventeen, the quotient will give the number of pounds equivalent to the weight of an atmospheric column of one foot; and the weight of the apparatus, being divided again by this quotient, the result will express the entire altitute of an equiponderant column. Of the altitude, the square root multiplied by eight will denote the final velocity, or that with which the parachute must strike the ground. But the actual resistance of the air is rather greater than what theory would give; and it is besides augmented by the concavity of the opposing surface, which occasions an accumulation of the fluid.

A parachute of a hemispherical form, twenty-five feet in diameter, is all sufficient to let down an ordinary sized man from any height in safety. But it will be shown, in the course of this work, that the balloon itself will form a parachute, in case of bursting while aloft. This happened to the author of this work during an ascension he made from Easton, Pennsylvania; and afterwards in an excursion from the city of Philadelphia, the minute details of which will be given in another part of this work. Although the arrangements and descent by parachute are as easy and simple as are the constructing of and ascending with a balloon, still there are few who have ever ventured to try it. This may be ascribed mainly to two causes: First, a want of knowledge of the scientific principles by which it is governed; and secondly, because there appears to be no great utility concerned in its practice; but merely the novelty of seeing a person, as it were, jump from the clouds to the earth without being injured.

CHAPTER VIII.

Aerostatic institute—The French applying the art to the warlike aggrandizement of their nation—Practicing school at Mendon—New method of generating hydrogen gas—Balloons for the French army—Battle of Fleurus gained by aid of balloon *reconnaissance*—Balloons for surveying, and electrical experiments.

In the early part of the French revolutionary war, when ingenuity and science were so eagerly called into active service, the *savans* of the French Academy recommended the use of balloons, as a fertile means of *reconnaissance*. Under these auspices, an aeronautic school was established at Mendon, near Paris. It was got up with the utmost secrecy, so that the powers opposed to the French could not avail themselves of its advantages, until the first projectors had already used it in such an effective manner as to greatly paralyze the allied powers. In order to have it at once facile and useful, it was necessary to have it reduced to systematic practice. The management of the institution was committed to the most eminent philosophers of Paris. Guyton Morveau, the celebrated French chemist, and M. Contel, superintended its operations. Fifty young military students were admitted to this school for training. A balloon of thirty-two feet in diameter was constructed, of the most durable materials, as a practicing machine for these pupils. Although the original plan of generating hydrogen gas was by decomposing water with the aid of oil of vitriol, and iron filings and borings, Morveau introduced another method in this case. For this purpose, six iron cylinders had been fixed by masonry in a simple kind of furnace, each of their ends projecting, and covered with an iron lid. Two sets of metal tubes were also inserted into these lids, one for conveying in the water, and the other for carrying off the gas which was formed from the water. The cylinders being charged with iron turnings, and brought to a red heat, the humidity of the water was instantly converted into steam, whose expanded particles were soon decomposed, by the oxygen uniting with the red-hot iron, forming an oxide of iron, while the hydrogen was thus freed, and forced out by its own pressure, from the other tube, and from thence through a washer of lime water, to deposit its carbonic acid gas, that might adhere to it, when it was perfectly pure and ready for the balloon. By this method, they procured, at a very moderate expense, a quantity of gas sufficient to inflate a balloon thirty-two feet in diameter, which holds 17,000 cubic feet, in the space of four hours. The practicing balloon was kept constantly full, so as to be at all times ready for exercise, and when not in use, it was fastened to the terrace of the lodge, in the open air. Whenever the weather was fair, the colonel of the corps and a pupil seated themselves in the car, when the machine was suffered to rise five or six hundred feet, arranged by cord and windlass. This primary movement became an object of great interest, from the advantages it seemed to possess. Paris, at this time being the great military focus of the world, could by these means view with Argus eyes the movements around the great metropolis. Telegraphic communication was greatly facilitated to the governmental centre by the aeronautic observers. A balloon was also constructed for this school, which, when filled with hydrogen, required the strength of twenty men to keep it to the earth. It could, after the lapse of two months, without, in the mean time, replenishing it with gas, raise into the air two men, with necessary ballast and all the instruments of observation. The eminent artist, M. Contel, constructed balloons specially appropriated to the different divisions of the French army. The *Entreprenant* for the army of the north, the *Celeste* for that of the Sambre and Meuse, the *Hercule* for the army of the Rhine and Moselle, and the *Intrepide* for the memorable army of Egypt.

In June, 1794, M. Contel ascended in the war balloon *Entreprenant*, to reconnoiter the hostile army, just before the battle of Fleurus, accompanied by an adjutant and general. They rose to a height of several thousand feet, with their windlass machinery so arranged that they could make it stationary at any given altitude. They mounted twice in the course of that day, and remained up each time about four hours. During the second aerial *reconnaissance*, they were discovered by the enemy, causing consternation and surprise within their lines. A brisk cannonade upon the aerial man-of-war ship, however, soon followed; but the observers, not being very high at the time, soon elevated themselves to a point at which they finished their observations, in defiance of the enemy's cannon. Upon this they descended safely, and by the signals communicated to General Jourdan, he was enabled to gain a speedy and decisive victory over the Austrian forces on the plains of Fleurus.

The French government also introduced the art of aeronautics to the utility of surveying and locating geographical lines. M. Lomet was appointed to superintend these operations. He found considerable difficulty in his observations from the irregular motion of the balloon, over which he had no controlling power. He, however, concluded that the practice of aerial topographing was of great use in facilitating geographical surveys.

The Abbé Bertholon also used balloons in his electrical experiments. They were sent up attached to long slender wires, which were fastened to the earth by the intervention of glass rods, or some other non-conducting substance. The balloons had fine projecting pointed wires proceeding from them; these wires connected with the main conducting wire which went down to the earth, where it was connected with a prime receiver. By this method, he was enabled to collect the electric fluid in abundance. I would, however, caution experimenters who may become engaged in this way. Trying this method with merely a hempen line for the main cord, which was wetted with a metallized solution as the balloon ran up with it, I found the sparks so rapid and powerful, given out from a tin ball six inches in diameter, which was insulated below, as to make it extremely painful to draw them off by the bare hand, and they became so extremely rapid that I was induced to desist, for fear of serious consequences. This experiment I made immediately preceding a thunder-storm, and the balloon was not more than four hundred feet high. Any danger liable to arise from such experiments might, however, be avoided, by having the fixtures and instruments properly arranged for the purpose.

CHAPTER IX.

Philosophical aerial voyage of Gay Lussac and Biot—Their experiments—Second ascent of Lussac—His experiments.

"AFTER the capitulation at Cairo, the balloon which had been sent to Egypt was returned to Paris, after the French army had returned from the African deserts. Two young and ardent French philosophers, MM. Biot and Gay Lussac, proposed to undertake an aerial excursion, in order to examine the magnetic force at great elevations, and to explore the constitution of the higher atmosphere and its electrical properties. For such a philosophical enterprise they were eminently qualified, having been educated together at the Polytechnic School of Paris, and both of them deeply versed in mathematics; the former indulging in a wide range of study, and the latter concentrating his efforts more on chemistry, and its application to the arts. Their offer to government was seconded by Berthollet and Laplace, and the celebrated chemist Chaptal, then minister of the interior, gave it his patronage and warm support. The war balloon which had once been in Egypt was now given to the custody of Biot and Gay Lussac; and the same artist who constructed it was, at the public expense, ordered to refit and prepare it under their direction. Besides the usual provision of barometers, thermometers, hygrometers, and electrometers, they had two compasses, and a dipping needle, with another fine needle, carefully magnetized, and suspended by a very delicate silk thread, for ascertaining by its vibrations the force of magnetic attraction. To examine the electricity of the different strata of the atmosphere, they carried several metallic wires, from sixty to three hundred feet in length, and a small electrophorus feebly charged. For galvanic experiments, they had procured a few discs of zinc and copper, with some frogs, to which they added some insects and birds. It was also intended to bring down a portion of air from the higher regions, to be subjected to a chemical analysis; and for this purpose a flask, carefully exhausted, and fitted with a stopcock, had been prepared for them.

The balloon was placed in the garden of the *Conservatoire des Arts*, or Repository of Models, formerly the Convent of St. Martin; and no pains were spared by Contel in providing whatever might contribute to the greater safety and convenience of the experimental voyagers. Everything being now ready for their ascent, these adventurous philosophers, in the presence of a few friends, embarked in the car at ten o'clock on the morning of the 23d of August, 1804. The barometer was then at 30.13 inches, the thermometer at 61° on Fahrenheit's scale, and Saussure's hygrometer pointed at 80.8°, or very nearly the limit of absolute humidity. They rose with a slow and imposing motion. Their feelings were at first absorbed in the novelty and magnificence of the spectacle which opened before them; and their ears were saluted with the buzz of distant gratulations, sent up from the admiring spectators. In a few minutes, they entered the region of the clouds, which seemed like a thin fog, and gave them a slight sensation of humidity. The balloon had now become quite inflated, and they were obliged to let part of the gas escape by opening the upper valve; at the same time they threw out some ballast, to gain a greater elevation. They now shot up through the range of clouds, and reached an altitude of about 6500 English feet. These clouds, viewed from above, had the ordinary whitish appearance; they all occupied the same height, only their upper surface seemed marked with gentle swells and undulations, exactly resembling the aspect of a wide plain covered with snow.

MM. Biot and Gay Lussac now began their experimental operations. The magnetic needle was attracted, as usual, by iron; but they found it impossible at this time to determine with accuracy its rate of oscillation, owing to a slow rotary motion with which the balloon was affected. In the meanwhile, therefore, they made other observations. A voltaic pile, consisting of twenty pairs of plates, exhibited all its ordinary effects: gave the pungent taste, excited the nervous commotion, and occasioned the decomposition of water. By rejecting some more ballast, they had attained the altitude of 8940 feet, but afterwards settled to that of 8600 feet. At this great elevation, the animals which they carried with them appeared to suffer from the rarity of the air. They let off a violet bee, which flew away swiftly, making a humming noise. The thermometer had fallen to 56° Fahrenheit, yet they felt no cold; they were, on the contrary, scorched by the sun's rays,* and were obliged to lay aside their gloves. Both of them had their pulses much accelerated; that of Biot, which generally beat seventy-six times in a minute, was raised to one hundred and eleven; while the pulse of his friend, Gay Lussac, a man of a less robust frame, was heightened from sixty to eighty beats in the minute. Notwithstanding their quickened pulsation, however, they experienced no sort of uneasiness, nor any difficulty in breathing.

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* I have always found the sun oppressive when sailing over dense strata of clouds, which is caused by reflection. This was the case in this instance.

What perplexed them most was the difficulty of observing the oscillations of a delicately suspended magnetic needle. But they soon remarked, on looking attentively down upon the surface of the conglomerated clouds, that the balloon slowly revolved, first in one direction, and then returned the contrary way. Between the opposite motions, there intervened short pauses of rest, which it was necessary for them to seize. Watching, therefore, the moments of quiescence, they set the needle to vibrate, but were unable to count more than five, or, very rarely, ten oscillations. A number of trials, made between the altitudes of 9500 and 13,000 feet, gave 7″ for the mean length of an oscillation, while, at the surface of the earth, it required $7\frac{1}{20}''$ to perform each oscillation. A difference so very minute as the hundred and fortieth part could only be imputed to the imperfection of the experiment; and it was hence fairly concluded, that the force of magnetic attraction had, in no degree, diminished at the greatest elevation which they could reach. The direction of this force, too, seemed, from the concurring circumstances, to have continued the same; though they could not depend on observations made in their vacillating car with so delicate an instrument as the dipping needle.

At the altitude of 11,000 feet, they liberated a green linnet, which flew away directly; but, soon feeling itself abandoned in the midst of an unknown ocean, it returned and settled on the stays of the balloon. Then, mustering fresh courage, it took a second flight, and dashed downwards to the earth, describing a tortuous yet almost perpendicular track. A pigeon, which they let off under similar circumstances, afforded a more curious spectacle. Placed on the edge of the car, it rested awhile, measuring, as it were, the breadth of that unexplored sea which it designed to traverse; now launching into the abyss, it fluttered irregularly, and seemed, at first, to try its wings on the thin element, till, after a few strokes, it gained more confidence, and, whirling in large circles or spirals, like the birds of prey, it precipitated itself towards the mass of extended clouds, where it was lost from sight.

It was difficult, in those lofty and rather humid regions, to make electrical observations; and the attention of the scientific navigators was, besides, occupied chiefly by their magnetical experiments. However, they let down from the car an insulated metallic wire of about 250 feet in length, and ascertained, by means of the electrophorus, that the upper end indicated resinous or negative electricity. This experiment was several times repeated; and it seemed to corroborate fully the previous observations of Saussure and Volta, relative to the increase of electricity met with in ascending the atmosphere.

The diminution of temperature in the higher regions was found less than what it generally is at the same altitude on mountains.* The hygrometer, or rather hygroscope, of Saussure, advanced regularly towards dryness, in proportion to the altitude which they attained. At the elevation of 13,000 feet, it had changed from 80°.8 to 30°. But still the conclusion, that the air of the higher strata is drier than that of the lower, we are inclined to consider as fallacious. In fact, the indications of the hygroscope depend on the relative attraction for humidity possessed by the substance employed, and the medium in which it is immersed. But air has its disposition to retain moisture always augmented by rarefaction, and, consequently, such alteration alone must materially affect the hygroscope. The only accurate instrument for ascertaining the condition of air with respect to dryness is founded on a property of evaporation. But we shall afterwards have occasion to refer to this.

The ballast now being almost quite expended, it was resolved to descend. The aeronauts, therefore, pulled the upper valve, and allowed part of the hydrogen gas to escape. They dropped gradually, and when they came to the height of 4000 feet, they met the stratum of clouds, extending horizontally, but with a surface heaved in gentle swells. When they reached the ground, no people were near them to stop the balloon, which dragged them in the car to some distance along the fields. From this awkward and even dangerous situation, they could not extricate themselves without discharging a great quantity of gas, and, therefore, gave up the idea of sending Gay Lussac up alone to explore the highest regions. It has been reported, that his companion Biot, though a man of activity, and not deficient in personal courage, was so much overpowered by the alarms of their descent, as to lose for the time the entire possession of himself. The place where they alighted, at half-past one o'clock, after three hours and a half spent in the midst of the atmosphere, was near the village of Meriville, in the department of the Loiret, and about fifty miles from Paris.

Several philosophers of Paris now desired that Gay Lussac should mount a second time, and repeat the different observations at the greatest elevation he could attain. Experience had instructed him to reduce his apparatus, and to adapt it better to the actual circumstances. As he could only count the vibrations of the magnetic needle during the very short intervals which occurred between the contrary rotations of the balloon, he preferred one about six inches in length, which, therefore, oscillated more quickly. The dipping needle was magnetized and adjusted by the ingenious M. Coulomb. To protect the thermometer from the direct action of the sun, it was enclosed within two concentric cylinders of pasteboard covered with gilt paper. The hygrometers, constructed by Richer's mode, with four hairs, were sheltered nearly in the same way. The two glass flasks, intended to bring down air from the highest regions of the atmosphere, had been exhausted, till the mercurial gauge stood at the twenty-fifth part of an inch, and their stopcocks were so perfectly fitted, that, after the lapse of eight days, they still preserved the vacuum. These articles, with two barometers, were the principal instruments which Gay Lussac took with him. The skill and intelligence of the artist had been exerted in further precautions for the safety of the balloon.

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* This want of diminution was caused by the reflection of the sun from the cloud stratum below them.

At forty minutes after nine o'clock, on the morning of the 15th of September, 1804, the scientific voyager ascended, as before, from the garden of the Repository of Models. The barometer then stood at 30.66 English inches, the thermometer at 82° Fahr., and the hygrometer at 57½°. The sky was unclouded, but misty. Scarcely had the observer reached the height of 3000 feet, when he observed spread below him, over the whole extent of the atmosphere, a thin vapor, which rendered the distant objects very indistinct. Having gained an altitude of 9950 feet, he set his needle to vibrate, and found it to perform twenty oscillations in 83″, though it had taken 84.33″ to make the same number at the surface of the earth. At the height of 12,680 feet, he discovered the variation of the compass to be precisely the same as below; but with all the pains he could take, he was unable to determine with sufficient certainty the dip of the needle. Gay Lussac continued to prosecute his other experiments with the same diligence, and with greater success. At the altitude of 14,480 feet, he found that a key, held in the magnetic direction, repelled with its lower end, and attracted with its upper end, the north pole of a needle of a small compass. This observation was repeated, and, with equal success, at the vast height of 20,150 feet—a clear proof that the magnetism of the earth exerts its influence at remote distances. He made not fewer than fifteen trials at different altitudes, with the oscillations of his finely suspended needle. It was generally to vibrate twenty or thirty times. The mean result gives 4.22″ for each oscillation, while it is 4.216″ at the surface of the earth—an apparent difference so extremely small, as to be fairly neglected.

During the whole of this gradual ascent, he noticed, at short intervals, the state of the barometer, the thermometer, and the hygrometer. Of these observations, amounting in all to twenty-one, he has given a tabular view. We regret, however, that he has neglected to mark the times at which they were made, since the results appear to have been very materially modified by the progress of the day. It would likewise have been desirable to have compared them with a register noted every half hour at the Observatory. From the surface of the earth to the height of 12,125 feet, the temperature of the atmosphere decreased regularly from 82° to 47°.3, by Fahrenheit's scale; but afterwards it increased again, and reached to 53°.6 at the altitude of 14,000 feet; evidently owing to the influence of the warm currents of air which, as the day advanced, rose continually from the heated ground. From that point the temperature diminished, with only slight deviations from a perfect regularity. At the height of 18,636 feet, the thermometer subsided to 32°.9, on the verge of congelation; but it sunk to 14°.9 at the enormous altitude of 22,912 feet above Paris, or 23,040 feet above the level of the sea, the utmost limit of the balloon's ascent.

From these observations no conclusive inference, we think, can be drawn respecting the mean gradation of cold which is maintained in the higher regions of the atmosphere; for, as we have already remarked, the several strata are, during the day, kept considerably above their permanent temperature by the hot currents raised from the surface through the action of the sun's rays. If we adopt the formula given by Professor Leslie at the end of his "Elements of Geometry," which was the result of some accurate and combined researches, the diminution of temperature corresponding to the first part of the ascent, or 12,125 feet, ought to have been 40° Fahr. It was actually 34°.7, and would no doubt have reached to 40°, if the progressive heating of the surface, during the interval of time, were taken into the account. In the next portion of the voyage, from the altitude of 14,000 to that of 18,636 feet, or the breadth of 4636 feet, the decrement of temperature, according to the formula, should have been only 16¼°, instead of 20°.7, which was really marked—a proof that the diurnal heat from below had not yet produced its full effect at such a great height. In the last portion of the balloon's ascent, from 18,636 feet to 22,912, a range of 4276 feet, the decrease of heat ought to have been 15½°, and it was actually 18°; owing, most probably, to the same cause, or the feebler influence which warm currents of air from the surface exert at those vast elevations. Taking the entire range of the ascent, or 22,912 feet, the diminution of temperature, according to the same formula, would be for the graduation of temperature in ascending the atmosphere 85°.4. The decrease actually observed would be 67°.1, which might be raised to 80°, if we admit the very probable supposition, that the surface of the earth had become heated from 82° to 94°.9 during the interval between ten o'clock in the morning and near three in the afternoon, when the balloon floated at its greatest elevation.

After making fair allowances, therefore, on account of the operation of deranging causes, the results obtained by Gay Lussac, for the gradation of temperature in the atmosphere, appear, on the whole, to agree very nearly with those derived from the formula which theory, guided by delicate experiments, had before assigned. This gradation is evidently not uniform, as some philosophers have assumed, but proceeds with augmented rapidity in the more elevated regions. The same conclusion results from a careful inspection of the facts which have been stated by other observers.

The hygrometers, during the ascent of the balloon, held a progress not quite so regular, but tending obviously towards dryness. At the height of 9950 feet they had changed from 57°.5 to 62°; from which they continued afterwards to decline, till they came to mark 27°.5, at the altitude of 15,190 feet. From this inferior limit the hygrometers advanced again, yet with some fluctuations, to 35°.1, which they indicated at the height of 18,460 feet. Above this altitude, the variation was slight, though rather inclining to humidity. There can exist no doubt, however, that, allowing for the influence of the prevailing cold, the higher strata of the atmosphere must be generally drier than the lower, or capable of retaining, at the same temperature, a larger share of moisture.

At the altitude of 21,460 feet, Gay Lussac opened one of his exhausted flasks; and, at that of 21,790 feet, the other. The air rushed into them through the narrow aperture, with a whistling noise. He still rose higher; but, at eleven minutes past three o'clock, he had attained the utmost limit of his ascent, and was then 22,912 feet above Paris—or 23,040 feet (being more than four miles and a quarter) above the level of the sea. The air was now more than twice as thin as ordinary, the barometer having sunk to 12.95 inches. From that tremendous altitude, 1600 feet higher than the summit of the Andes, more elevated than the loftiest pinnacle of our globe, and far above the height to which any mortal had ever soared, the aerial navigator might have indulged the feelings of triumphant enthusiasm. But the philosopher, in perfect security, was more intent on calmly pursuing his observations. During his former ascent, he saw the fleecy clouds spread out below him, while the canopy of heaven seemed of the deepest azure; more intense than Prussian blue. This time, however, he perceived no clouds gathered near the surface, but remarked a range of them, stretching at a very considerable height over his head; the atmosphere, too, wanted transparency, and had a dull, misty appearance. The different aspect of the sky was probably owing to the direction of the wind, which blew from the northwest in his first voyage, but in his second from the southeast.

While occupied with experiments at this enormous elevation, he began, though warmly clad, to suffer from excessive cold, and his hands, by continual exposure, grew benumbed. He felt likewise a difficulty in breathing, and his pulse and respiration were much quickened. His throat became parched from inhaling the dry, attenuated air, so that he could hardly swallow a morsel of bread; but he experienced no other direct inconvenience from his situation. He had indeed been affected, through the whole of the day, with a slight headache, brought on by the preceding fatigues and want of sleep; but though it continued without abatement, it was not increased by his ascent.

The balloon was now completely distended, and not more than thirty-three pounds of ballast remained; it began to drop, and Gay Lussac, therefore, only sought to regulate its descent. It subsided very gently, at the rate of about a mile in eight minutes; and after the lapse of about thirty-four minutes, or at three-quarters after three o'clock, the anchor touched the ground, and instantly secured the car. The voyager alighted with great ease near the hamlet of St. Gourgan, about sixteen miles from Rouen. The inhabitants flocked around him, offering him assistance, and eager to gratify their curiosity.

As soon as he reached Paris, he hastened to the laboratory of the Polytechnic School, with his flasks, containing air of the higher regions, and proceeded to analyze it in the presence of Thenard and Gresset. Opened under water, the liquid rushed into them, and apparently half filled their capacity. The transported air was found, by a very delicate analysis, to contain exactly the same proportions as that collected near the surface of the earth, every 1000 parts holding 215 of oxygen. From concurring observations, therefore, we may conclude that the atmosphere is essentially the same in all situations.

The ascents performed by MM. Biot and Gay Lussac are memorable, as being the first ever undertaken solely for objects of science. It is impossible not to admire the intrepid coolness with which they conducted those experiments, operating, while they floated in the highest regions of the atmosphere, with the same composure and precision as if they had been quietly seated in their cabinet at Paris. Their observations on the force of terrestrial magnetism show, most conclusively, its deep source and wide extension. The identity of the constitution of the atmosphere, to a vast altitude, was likewise ascertained. The facts noted by Gay Lussac, relative to the state of the thermometer at different heights, appear generally to confirm the law which theory assigns for the gradation of temperature in the atmosphere; but many interesting points were left untouched by this philosopher. We are sorry that he had not carried with him the *cyanometer*, which enabled Saussure to determine the color of the sky on the summits of the Swiss mountains; still more do we regret that he was not provided with an hygrometer and a photometer, of Leslie's construction. These delicate instruments could not have failed, in his hands, to furnish important data for discovering the relative dryness and transparency of the different strata of air. It would have been extremely interesting, at such a tremendous height, to have measured with accuracy the feeble light reflected from the azure canopy of heaven, and the intense force of the sun's direct rays, and, hence, to have determined what portion of them is absorbed in their passage through the lower and denser atmosphere.

CHAPTER X.

Suggestions on the use of balloons soon after their discovery.

"BALLOONS have at different times been thought capable of useful application. It has been even proposed to employ their power of ascension as a mechanical force. This might be rendered efficient, it was believed, to raise water from mines, or to transport obelisks, and place them on great elevations. We can easily imagine situations where a balloon could be used with advantage; such as to raise, without any scaffolding, a cross or a vane to the top of a high spire; but the power would then be purchased at a very disproportionate expense. It would require four and a half pounds of iron, or six of zinc, with equal quantities of sulphuric acid, to yield hydrogen gas sufficient to raise up the weight of a pound. Balloons have rendered important service in reconnoitering the face of a country, and communicating military signals; and it is rather surprising that a system, which promised such obvious advantages, has not been carried much farther.

"But to a skilful and judicious application of balloons, we may yet look for a most essential improvement of the infant science of meteorology. Confined to the surface of this globe, we have no direct intimation of what passes in the lofty regions of the atmosphere. All the changes of weather, which appear so capricious and perplexing, proceed, no doubt, from the combination of a very few simple causes. Were the philosopher to penetrate beyond the seat of the clouds, examine the circumstances of their formation, and mark the prevailing currents, he would probably remove, in part, the veil that conceals those mighty operations. It would be quite practicable, we conceive, to reach an elevation of seven miles, where the air would be four times more attenuated than ordinary. A silk balloon of forty feet diameter, if properly constructed, might be sufficient for that enormous ascent, though not more than one-fourth filled with hydrogen gas. The voyager would not, we presume, suffer any serious inconvenience from breathing the thin air;* the animal frame adapts itself with wonderful facility to external circumstances. Perhaps the quickened pulse and short respiration which some travelers have experienced on the summits of lofty mountains, should be attributed chiefly to the suddenness of their transition, and the severity of the cold. The people of Quito live comfortably 9560 feet above the level of the sea; and the shepherds of the hamlet of Antisana, the highest inhabited spot in the known world, who breathe, at an elevation of 13,500 feet, air that has only three-fifths of the usual density, are nowise deficient in health or vigor. But the intenseness of the cold is, probably, what the resolute observer would have most to dread, at the height of seven miles. This decrease of temperature, perhaps equal to 148°, might extend below the point at which mercury freezes; yet several circumstances tend to mitigate such extreme cold, and proper clothing might enable an experimenter for a short time to resist its effects.

"Much could be done, however, without risk or material expense. Balloons from fifteen to thirty feet in diameter, and carrying register thermometers and barometers, might be capable of ascending alone to altitudes between eight and twelve miles. Dispatched from the centres of the great continents, they would not only determine the extreme gradations of cold, but indicate by their flight, the direction of the regular and periodic winds, which doubtless obtain in the highest regions of the atmosphere.

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* He would suffer from a diminution of atmospheric pressure. At the surface of the earth, an ordinary sized man sustains an atmospheric pressure of over 25,000 pounds, while at the height of seven miles he would have but 6500 pounds. From what I have experienced at three and a quarter miles high, I would suppose very serious consequences would ensue at that immense height.

But we will not enlarge. In some happier times, such experiments may be performed with the zealous concurrence of different governments; when nations shall at least become satisfied with cultivating the arts of peace, instead of wasting their energies in sanguinary, destructive, and fruitless wars."

CHAPTER XI.

Aerial voyage of M. Mosment, from Lisle—Lost his life by it—Nocturnal aerial voyage of M. Garnerin, from Paris—His ascent from Tivoli—Perilous trip—Caught in a thunder storm.

On the 7th of April, 1806, M. Mosment, an experienced aeronaut, undertook an aerial voyage from Lisle. He ascended at noon, waving a flag decorated with the imperial eagle of France, amid the shouts of the assembled spectators. The commencement of his career was so rapid as to bear him in a very short time beyond the vision of the crowd. During his ascent, he dropped an animal attached to a parachute, which came safely to the ground. About one o'clock, something was observed slowly descending through the atmosphere, which proved on its fall to be the flag which M. Mosment had carried along with him. Very soon afterwards, a murmur circulated through the crowd, and the body of the unfortunate aeronaut was discovered in one of the fosses of the city, lifeless, and covered with blood. The balloon reached the ground on the same day, at the distance of twenty-five leagues from Lisle; the car containing nothing except an unloaded pistol, a little bread, and a piece of flesh. M. Garnerin ascribes this melancholy disaster to the extreme shallowness of the car, and the too great distance between the cords which attached it to the balloon; and is of opinion that M. Mosment, when leaning over the car to drop the animal, had lost his balance, and was precipitated to the earth.

Of all the voyages which the history of aeronautics presents to our notice, the *nocturnal* aerial excursions of M. Garnerin must be ranked among the most enterprising and adventurous. At eleven o'clock on the evening of the 4th of August, 1807, he ascended from Tivoli, at Paris, under the Russian flag, as a token of the peace that subsisted between France and Russia. His balloon was illuminated by twenty lamps; and to obviate all danger of communication between these and the hydrogen gas which it might be necessary to discharge in the course of the voyage, the nearest of the lamps was fourteen feet distant from the balloon, and conductors were provided to carry the gas away in an opposite direction. After his ascent, rockets, which had been let off from Tivoli, seemed to him scarcely to rise above the earth, and Paris, with all its lamps, appeared like a plain studded with luminous spots. In forty minutes, he found himself at an elevation of 13,200 feet, when, in consequence of the dilatation of the balloon, he was under the necessity of discharging part of the inflammable air. About twelve o'clock, when 3,600 feet from the earth, he heard the barking of dogs; about two, he saw several meteors flying around him, but none of them so near as to create apprehension. At half past three, he beheld the sun emerging in brilliant majesty, above an ocean of clouds, and the gas in the balloon being thereby expanded, it soon rose 15,000 feet above the surface of the earth, where he felt the cold exceedingly intense. In seven hours and a half from his departure, M. Garnerin descended near Loges, forty-five leagues distant from Paris.

This same intrepid aeronaut undertook a second nocturnal voyage on the 21st of September, 1807, in the course of which he was exposed to the most imminent danger. M. Garnerin prognosticating an approaching storm, from the state of the atmosphere, refused to be accompanied by M. de Chassenton, who earnestly requested it. He ascended, therefore, alone from Tivoli, at ten o'clock, and was carried up with unexampled rapidity to an immense height above the clouds. The balloon was then dilated to an alarming degree, and M. Garnerin, having been prevented by the turbulence of the mob, before his ascent, from regulating those parts of the apparatus which were meant to conduct the gas away from the lamps on its escape, was totally incapable of managing the balloon. He had no alternative left, therefore, than with one hand to make an opening, two feet in diameter, through which the inflammable air was discharged in great quantities, and with the other to extinguish as many of the lamps as he could possibly reach. The aeronaut was now without a regulating valve; and the balloon, subject to every caprice of the whirlwind, was tossed about from current to current. When the storm impelled him downwards, he was forced to throw out his ballast, to restore the ascending tendency; and at last every resource being exhausted, no expedient was left him to provide against future emergencies. In this forlorn condition, the balloon rose through thick clouds, and afterwards sunk; and the car, having struck against the ground with a violent impulse, rebounded from it to a considerable altitude. The fury of the storm dashed him against the mountains, and, after many rude agitations and severe shocks, he was reduced to a state of temporary insensibility. On recovering from his perilous situation, he reached Mont Tonnerre in a storm of thunder. A very short period after this, his anchor hooked in a tree, and in seven hours and a half, after a voyage which had nearly proved fatal to him, he landed at the distance of 300 miles from Paris.

We might enumerate a great many voyages undertaken with balloons about the beginning of the present century; but we have preferred to take only such from among them as seem to be best calculated to impart useful information on the subject to the student of aeronautics. Some of the accounts are also too highly exaggerated to enter a sober history.

CHAPTER XII.

From the Encyclopædia Britannica—Buoyant force of balloons—Celerity of ascent—Stability of suspension.

The following interesting calculations made to ascertain the mathematical buoyancy, expansion, velocity of ascent, &c., of balloons is taken entire from the Encyclopædia Britannica, it being useful to the student of aeronautics; but at the same time it must be considered as purely theoretical—a part of the science very essential to the aeronaut, although he will find a great difference between theory and practice. Upon the latter, we shall treat fully in another part of this work.

I. *The Buoyant Force of Balloons.*—Since balloons in their shape generally approach to the spherical form, it will be more convenient to ground our calculations on that figure. A globe one foot in diameter of common air at the level of the sea, and of the mean density and temperature, is found to weigh about the twenty-fifth part of a pound avoirdupois. Consequently, if a perfect vacuum could be procured, a balloon of ten feet diameter must rise with a force of forty pounds; one of twenty feet diameter with that of 320 pounds; and a balloon of thirty feet diameter would mount in the atmosphere with the power of 1080 pounds, thus augmenting always in the ratio of the cube of the diameter. But air expands by heat about the 450th part of its bulk for each degree on Fahrenheit's scale; supposing, therefore, that the air included within the balloon were heated fifty degrees, it would follow that one-ninth part of this fluid would be driven out of it by the warmth, and consequently, that the tendency of the balloon to rise upwards would be equal only to the ninth part of the entire power of ascension. Were it possible to maintain a heat of seventy-five degrees within the balloon, the buoyant force would yet not exceed the sixth part of the absolute ascensional power.

The dilatation which the presence of humidity communicates to air will, during fine weather in this climate, amount generally to one-eighteenth part, though it may sometimes reach to more than the double of this quantity. But in the tropical regions, such dilatation will commonly exceed the twentieth part of the volume of fluid. Hence moist air thrown into a bag, likewise wetted, and sufficiently large, would cause it to rise in the atmosphere. To succeed, however, in this way, the balloon constructed of coarse linen would require enormous dimensions, not less than three hundred feet in diameter.

But it is the union of heat and moisture that gives to air the greatest expansion. The white smoke with which the balloons are filled on the Montgolfiers' plan, was found by computation to be at least one-third specifically lighter than the external air. This purer sort of smoke is scarcely anything but air itself charged with vapor, being produced by the burning of chopped straw and vine twigs in a brasier, under the orifice of the balloon. It would have required no fewer than 150° of heat alone to cause the same extent of rarefaction.

We have, therefore, sufficient data for calculating the buoyant force of the common fire, or smoke balloons. This force being estimated about twelve and a half pounds avoirdupois, when the diameter of the balloon is ten feet, would amount to 1562½ pounds, if the diameter were fifty feet, and to 12,500 pounds if it were a hundred feet. The weight of the linen case may be reckoned at two-fifths of a pound for a sphere of one foot in diameter. Consequently, a balloon of ten feet diameter would, without its appendages, weigh forty pounds; one of fifty feet diameter, 1000 pounds; and one of a hundred feet diameter, 4000 pounds. Such a balloon of ten feet diameter would need twenty-seven and a half pounds to make it rise; but one of fifty feet diameter would ascend with a force of 562½ pounds, and one of a hundred feet diameter would exert an ascending power of not less than 8500 pounds. There is besides to be deducted the weight of the cordage, the car, the ballast, and the passengers. It would require, on these estimates, a diameter of thirty-three and a half feet, to procure merely an equilibrium between the weight of the canvass and the buoyant force of the rarefied air.

The hydrogen gas obtained from the action of dilute sulphuric acid upon iron filings is only six times lighter than atmospheric air; but the gas evolved during the solution of zinc in that acid, is not less than twelve times lighter than common air. The ordinary way of examining the specific gravity of the different gases requires a very nice operation—weighing with the most exquisite balance; a serious difficulty, which long retarded our knowledge of their comparative densities. In one of the notes to his "Treatise on Heat," Professor Leslie has pointed out a very simple method, founded on the principles of pneumatics, for discovering the relative specific gravities of the aeriform fluids. This consists in observing the time that a given portion of the gas, under a determinate pressure, takes to escape through a very small aperture. The density of the gaseous fluid must be inversely as the square of the interval elapsed. Thus, the hydrogen gas procured from zinc, but without any depuration, was found, under the pressure of the same column of water, to flow thrice as fast as atmospheric air. This experiment is very striking, and requires no more apparatus than a cylindrical jar, open below and surmounted by a cap terminating in a fine tubular orifice.

On a very moderate supposition, therefore, and after making every allowance for imperfect operation, we may consider the hydrogen gas which fills a balloon as six times lighter than an equal bulk of common air. Consequently, such a balloon must exert five-sixths of the whole buoyant force corresponding to its capacity, or will have a tendency to mount in the atmosphere, that is equal to the thirtieth part of a pound avoirdupois for a globe of one foot in diameter. A spherical balloon of fifteen feet diameter would hence have a buoyancy of 112¼ pounds; one of thirty feet, 900 pounds; and one of sixty feet no less than 7200 pounds. Here follows an estimate of the weight of the silk used in balloons, which of course is to be deducted from the above ascensional powers, but which is much lighter than the silk I would recommend for such purposes. It is, therefore, omitted, as the aeronaut can make that calculation best from the balloon actually in use.

But the calculations now given would in strictness require a small modification. The weight of the envelop and all appendages must evidently compress the included gas, and thereby render it in some degree denser. To compute this minute effect, we have only to consider that the pressure of a column of atmosphere, at the mean temperature, and near the level of the sea, is 1632 pounds, on a circle of a foot diameter. Thus, in the balloon of sixty feet diameter, if we suppose the whole load to have been 6000 pounds, the compression of the bag would only amount to five-thirds of a pound for each circle of a foot diameter in the horizontal section, or correspond to the 979th part of the entire pressure of the atmosphere. But the weight of the confined gas being 1200 pounds, its buoyancy must have suffered a diminution of somewhat more than a pound, or $\frac{1}{11}$th from the incumbrance opposed to it. This connection is, therefore, a mere theoretical nicety, which may be totally disregarded in practice.

II. The next circumstance to be considered in aeronautics, is *the celerity with which balloons make their ascent.* It is obvious that the efficient power of ascension, or the excess of the whole buoyant force above the absolute weight of the apparatus, would by acting constantly produce always an accelerated motion. But this acceleration is very soon checked, and a uniform progress maintained, by the increasing resistance which the huge mass must encounter in its passage through the air. The velocity which a balloon would gain from unobstructed acceleration must, from the theory of dynamics, be to that which a falling body acquires in the same time as the efficient buoyancy is to the aggregate weight of the apparatus and of the contained fluid. Thus, if a balloon were to rise with a force equal to the eighth part of its compound weight, the celerity resulting from a constant acceleration would be expressed by multiplying four feet into the number of seconds elapsed since it was launched into the air. Its accelerating advance, however, being opposed, the balloon may to all appearance attain, though still affected with partial oscillations, the final velocity in perhaps little more than double the time required without such obstruction.

This final velocity, or the velocity at which the ascent becomes uniform, the resistance from the air being then equal to the efficient buoyancy of the balloon, is easily calculated. The resistance a circle encounters in moving through any fluid in the direction perpendicular to its plane, is measured by the weight of a column of that fluid, having the circle for its base, and an altitude equal to the height from which a heavy body in falling would acquire the given celerity. But near the level of the sea, and at the mean temperature, a column of atmospheric air seventeen feet high, and incumbent on a circle of one foot diameter, weighs a pound avoirdupois; which is therefore the resistance that a circle would suffer if carried forwards with the celerity of thirty-three feet each second. According to the same theory, however, which we owe to the sagacity of Newton, the resistance of a sphere is just the half of that of its generating circle, and consequently a velocity of forty-six and two-fifths feet in a second through the air would in ordinary cases create a resistance of one pound to a ball of one foot diameter. In other circumstances, the quantity of resistance must be proportional to the square of velocities and of the diameters. Whence, if the buoyant power were always the same, the velocity of the ascent of a balloon would be inversely as its diameter.

Suppose a balloon to have thirty feet in diameter, and an ascensional power of 100 pounds. This effort is evidently the same as the ninth part of a pound for a globe of a foot in diameter, and would, therefore, be countervailed by the resistance corresponding to a velocity of $46\frac{2}{3}$ divided by 3, the square root of 9, or $15\frac{5}{9}$ feet a second. The balloon would, therefore, reach the altitude of a mile in about six minutes. Its accelerating force being equal to the sixteenth part of its total weight, it might have acquired the uniform motion of ascent in twenty seconds, or before it had attained the height of 200 feet. This example differs very little from reality, and the method of computation will be easily transferred to other cases.

But the resistance of the air assigned by theory is, from the circumstances omitted in the simplification of the problem, generally somewhat less than the results of observation. In low velocities, this difference amounts seldom to the fifth part of the whole effect; but in the high velocities it increases considerably, exceeding even the third part in certain extreme cases. From the numerous and accurate experiments of Dr. Charles Hutton, we may, however, deduce a simple formula for expressing the terminal velocity of balloons, or the celerity of their uniform ascent. To express the rule in words: As the diameter of the balloon in feet is to the constant number forty, so is the square root of the ascensional power in pounds to the terminal or uniform velocity of ascent each second. To illustrate the application of the formula by an example; suppose the balloon to have a diameter of sixty feet, with an accelerating power of 144 pounds; the corresponding rate of uniform ascent becomes eight feet each second, or about a mile in eleven minutes.

III. The last point which demands attention in aeronautics is, *the stability of the suspension of a balloon at any given height in the atmosphere.* The circumstances which regulate or determine that stability, requiring little exercise of thought, have been commonly neglected, and very seldom examined with due care. It will be proper to consider, *first*, the fire or smoke balloons; and, *secondly*, the balloons filled with hydrogen gas.

1. The warm humefied air of the balloon, constructed on Montgolfier's plan, suffering less external compression as it approaches the upper strata of the atmosphere, must, at the same time, necessarily expand, and partly escape by the orifice above the brasier. The weight of the included fluid, and that of the part expelled, constituting its buoyant force, will hence be reduced, in proportion to the diminished density of the medium in which it floats. The balloon will continue to ascend till its enfeebled buoyancy is no longer able to support the incumbent load. At the height of a mile above the surface, the power of ascension would be diminished rather more than one-fifth part; but, at an altitude of three miles and a half, it would be reduced to one-half.

At the ordinary temperature, this buoyancy would suffer a reduction of the hundredth part for each ascent of 278 feet.

For example, a balloon of 100 feet diameter, which is about the largest dimension of any yet constructed, near the level of the sea, and at the ordinary temperature, would have a power of ascension of 12,500 pounds; but at the height of 8000 feet, or somewhat more than a mile and a half, where the density is diminished one-fourth, that power becomes reduced to 9375 pounds, being a deficiency of 3125 pounds. On the supposition that the balloon was, at first, so much loaded, as to rest just suspended at the ground, a ballast of 3125 pounds must have been thrown out, to make it rise to the altitude of a mile and a half. Hence also the rejection of 125 pounds would have been sufficient to give the balloon an elevation of 278 feet. For the same reason, ten pounds of ballast heaved out would have raised it twenty-two feet at the surface, twenty-nine feet at the height of a mile and a half, and forty-four feet at that of three miles and a half.

2. The stability of the suspension of balloons filled with hydrogen gas must depend on principles which are very different and less marked. In these aeronautic machines, after the gas has been once introduced, it is closely shut up; and, therefore, having constantly the same absolute weight, it should likewise, in all situations, exert the same buoyant force. Hence, if the balloon were capable of indefinite expansion, it would still continue to ascend through unbounded space. The determinate capacity of the bag alone can oppose limits to its rise in the atmosphere. The upper strata being rarer than those below, will have less power to keep any given bulk suspended; and the actual buoyancy being diminished from that cause, the balloon will find its station at a corresponding height in the diffuse medium. But this diminution of the buoyant force, and the consequent increase in the bulk of the hydrogen gas, must necessarily be confined within very moderate limits, otherwise the thin silk case would be torn to shreds by the expansive efforts of the imprisoned fluid. A safety-valve is accordingly placed at the top of the balloon, calculated to give vent to the gas before the distension has become such as to endanger the bursting of the envelop.

A balloon should not at first be filled completely with hydrogen gas, but allowed to begin its ascent in a flaccid state. As it mounts into the rarer atmosphere, it will gradually swell, till it has attained its full distension, when the safety valve may come to act. But such dissipation of the gas ought, by a previous arrangement, to be as much as possible avoided. If the balloon were intended to rise to the height of four miles, it would not be requisite to fill more than half its capacity with the elastic fluid.

To push the charge any further in this case, would only occasion a superfluous waste of materials. By throwing out part of his ballast, the aeronaut may raise himself higher; and, by opening the valve to permit some of the imprisoned gas to escape, he may descend again; but both these expedients are attended by a wasteful expenditure of power.

It is evident that a balloon can have no stability of equipoise, so long as it remains in a loose or flaccid state. The slightest action would then be sufficient to make it rise or fall, since, under such circumstances, any change of its station could not, in the smallest degree, affect the measure of its buoyant force. The general elevation to which the balloon will ascend must be determined by its quantity of ballast, conjoined with the regulation of its safety valve; but the strain of the silk envelop itself would be sufficient to confine the ascent within certain limits, and to procure the stability of the floating mass. Thus, if a balloon, fully distended, had yet a slight disposition to rise, the imprisoned gas, suffering more and more compression as it gradually ascends, would become proportionally denser (in reference to its surrounding atmosphere), and, therefore, lose a corresponding part of its previous buoyancy. An equilibrium would hence soon obtain, which must arrest the floating machine at a determinate height in the atmosphere.

Suppose a balloon to be capable, without any danger of bursting, of sustaining an expansion equal to the hundredth part of the elasticity of the included fluid; the whole buoyancy would, by such an alteration, be diminished one five-hundredth part, or its floating power would subside fifty-five feet near the surface, and sink proportionally more in the upper regions. To produce the effect, it would only be requisite to throw common air into the balloon, without suffering the hydrogen to escape. On this principle, Muesnier, an ingenious French chemist, very soon after the discovery of balloons, proposed to regulate with nicety their ascent and position of equilibrium in the atmosphere. The mode which he suggested was to place within the principal balloon a much smaller one, to be filled occasionally with common air by help of bellows, or emptied again by opening an exterior valve. The aeronaut would thus have it in his power, without expending the charge of hydrogen gas, either to sink gently through a short space, or to rise again at will, by inflating the inner balloon, or allowing it to collapse. The adjustment of the height of a balloon could hence be managed with great precision.

The command possessed by the aeronaut of raising or depressing his machine at pleasure, might afford him the means of influencing the direction of its course. From the various motions of the several ranges of clouds, we may infer that different currents exist at the same time in the atmosphere. (I have found five within the height of one mile and three-quarters.) The aeronaut has, therefore, in his ascent, only to seek the current best suited to his purpose; and, taking his station in that stratum, to commit his vessel to the guidance of the stream.

CHAPTER XIII.

Prospects of aerial navigation—Fulton and Napoleon—General introduction of carburetted hydrogen auspicious to aerial navigation.

We have now taken a review of the experiments and trials in the art of aeronautics which transpired within the period of a few years after its discovery; and although it is frequently said that it has not been improved beyond its original invention, it is more than probable that the reader will come to a more favorable conclusion in the perusal of this work. True it may be that, as yet, no actual demonstration has been made to prove that we can sail from point to point with a balloon with the same precision and certainty that we can with steamships. And if we had no other prospects on which to rest our hopes and anticipations, in acquiring such perfection, we have at least the consolation to know that steamship navigation, for more than local purposes, was as much decried, and denounced as visionary, as a means of crossing the ocean, thirty years ago, as transatlantic balloon navigation is now. In 1801, Napoleon Bonaparte was rising in the most auspicious period of his glory, and his military genius was apparently concentrated upon the necessity of England's reduction. Concerning this, Alison says a singular circumstance occurred at that time, which demonstrates how little the clearest intellect can anticipate the ultimate result of the discoveries which are destined to effect the greatest changes in human affairs. At the time when all eyes in Europe were fixed on the Channel, and the orators of the French tribune were wishing for a "fair wind and thirty-six hours," an unknown individual (Robert Fulton) presented himself to the First Consul, and said: "The sea which separates you from your enemy gives him a great advantage. Aided alternately by the winds and tempests, he braves you in his inaccessible isle. This obstacle, his sole strength, I engage to overcome. I can, in spite of all his fleets, at any time, in a few hours, transport your armies into his territory, without fearing the tempests or having need of the winds. Consider the means which

I offer you." A most singular proposition was this, truly. Napoleon so far entertained it, as to commit the plans and details of Mr. Fulton to a commission of the most learned men which France could produce, and this was all that the First Consul's vast engagements would allow him to do. The most learned commission reported to Napoleon that it was "visionary and impracticable." Such was the reception which steam navigation, that has done so much, first received at the hands of philosophy.

It is even so with aerial navigation at the present day—condemned, and pronounced "visionary," instead of receiving that support and encouragement which would at least enable it to have a fair trial in the several ways that are at present proposed and urged. To hear the murmurings of some, that the art has not been improved, is one of the most happy omens, to the practical aeronaut, of what it soon will be. He alone is capable of fairly valuing this view of the subject, when he compares the knowledge and facilities we possess of its operations at the present day, with those at the period of its discovery. The cost of construction of balloons has been more than one-half reduced from what it was forty years ago. The means of making them impermeable to hydrogen gas has also been vastly improved, to say nothing of what is likely to come out of the important discoveries and improvements in gum elastic and gutta percha. Then comes the general introduction of carburetted hydrogen, or coal gas, into every important town in the United States, bringing within the compass of ordinary means the cost of inflating balloons, for experimental purposes. While the cost of inflating one of these machines which is capable of carrying an individual, amounted to at least one hundred and fifty dollars, by the vitriolic process, it costs but twenty-five or thirty dollars to fill one with coal gas, capable of raising the same weight, and affords a good profit to the gas companies at that. Here, then, a wide and desirable field is opening, and which, to a great extent, is already opened, calculated to give the art a new life, by inviting its friends and promoters to experiments and improvements, who are ever ready in such laudable objects, when the means to do so are placed within their reach. This is the more encouraging, because we are not groping in the dark, seeking an untried, unphilosophical phantom, but a mathematically demonstrated truth, which is only awaiting an actual realization. For, that the air is navigable is no longer to be denied—its practicability, as a generally useful art, is merely doubted.

CHAPTER XIV.

Pennington's flying machine—Connection of balloon with it—Anonymous claimant to the invention of screw propeller—His views on balloon sailing—Steam not adaptable to balloon propulsion—Henson's aerial steam carriage—A description of it from "Newton's Journal"—Its contrivance more ingenious than practicable.

In examining into, and commenting on, this subject, in its present condition, the means and contrivances which have been resorted to by various individuals, who have, in modern times, attempted to navigate the air with machines entirely independent of balloons, should not be overlooked. Although such a method seems to be behind the balloon principle, from its never yet having accomplished any real action to prove its efficiency, still, its various contrivances, some of them very ingenious, are not without value, and are, therefore, worthy of being fairly considered in this work. It is by examining every collateral and approximating advantage pertaining to this subject, in the minutest degree, that we shall be enabled to attain the highest point of perfection in the shortest possible time.

The first of these that we shall notice is the one suggested by Mr. John H. Pennington, of Baltimore, Md.

In order that a fair estimation may be made of Mr. Pennington's views on the subject of aerial navigation, connected with what he claims as his invention, his own explanation is here submitted:—

"The principle is the lateral pressure of the atmosphere, acting upon the inclined plane, the propelling power and wheel. The machine or inclined plane will resemble in figure the transverse section of a spheroid, in either side of which are openings for the purpose of admitting a pair of beveled wheels, by which the machine is to be propelled; and centrally situated between these is a small engine, by which the wheels are to be put in motion, by a chain band connected with the engine. It is proposed to have the engine made of steel, so as to secure the greatest possible strength in the smallest possible compass—and to use spirits of turpentine or alcohol, which boil at about thirty-three and a half per cent. less heat than water; when 300 per cent. of strength may be obtained by using these materials, and the same proportionate weight of metal being dispensed with, which being calculated to work two and a half or three horse power—and to carry 450 lbs. exclusively of weight of engine, fuel, and dilating fluid, averaging 500 lbs. more. This would make a total of 950 lbs., which would require an extent in width of about 125 feet by 375. This, multiplied by itself, and one-third of the quotient deducted, would leave the number of square feet contained in the area of the disc of the inclined plane of the machine.

"The wheels, which are intended to propel the plane forward, are spiral or beveled-winged, situated in openings on either side of the plane, and formed on the common principle of the wind-mill wheel. To the lower extremity of the plane is attached the steering power, capable of moving either vertically or horizontally. To calculate then the power of the machine, it must be considered in a state of equilibrium; that is, in the state where the power just balances it which is to overcome the resistance of the atmosphere. Having discovered what quantity of power will be requisite for this purpose, it will then be necessary to add so much more as to overcome the friction and weight of the machine itself, and to give the necessary velocity. The whole machine, then, in all its simplicity, resolves itself into the principle of the common boy's *kite*—the beveled-winged wheels, the momentum—and the engine, the power."

Having met with Mr. Pennington at Winchester, Va., while making arrangements for a balloon ascension from that place, I advised him to place a balloon, instead of a kite, as a buoyant power to his flying machine, which he at once adopted. He has deposited a model in the patent office at Washington; and in his pamphlet, purports to have entered it for letters patent, which, if so, is more likely to be improved than infringed; for, thus far, nothing has been realized by it. The application of beveled wheels to the propulsion of aerial machinery did not originate with Mr. Pennington, nor can it be ascribed to any one in particular, as the use of them would naturally suggest itself to any one who was engaged in the investigation of aerial navigation. Mr. C. Green, of London, the veteran aeronaut, used them in an experimental model of a flying machine, a balloon, at an exhibition of his air navigating machine before the Polytechnic School of London, before Mr. Pennington presented his claim to their application for such purpose.

The same principle is claimed as having been recommended at a period prior to the use of it in steamboats. We will take the claimant's communication to the "Philadelphia Sun" newspaper of 1843, in full, as being pertinent to the subject under consideration.

He says, "Though all the devices and projects directed to the object contained in the article you published on 'Navigating the Air,' I consider as inefficient or futile, yet I by no means think the idea visionary or impracticable, and therefore, they lead me to recur to a communication of mine, inserted in the 'United States Gazette,' of the 17th of June, 1828, now nearly twenty years ago, signed E. L. B. E. In it a contrivance is proposed for the purpose, which all previous and subsequent reflection and observation confirm me in believing adequate to effect it, though it has not yet attracted the practical attention of any one who may be competent, through his wealth and skill, to give it a fair trial, which I should be glad to assist a party in doing. As the date of that communication is so far in the rear, that perhaps few, if any, besides myself, remember anything of it, I will briefly recapitulate its scope. In it I contemplated the accomplishment of aerial navigation, by means of a mechanical contrivance, derived from the well-known power and operation of revolving inclined planes, as exemplified in a windmill, or in a child's plaything, displayed in almost every house, on the stove, during the winter. Therein I held that, as a current of air, acting against a system of confined inclined planes, causes them to revolve with great power, increasing in proportion to their surface and the strength of the current, so, if the power were reversed, the planes set free, and the force applied directly to them, they would project themselves *forward* with a corresponding force and velocity—the same as does a ship in similar circumstances—for, contrary to the common conception, three-fourths of a ship's sailing is performed by the sails acting as inclined planes against the current of wind, instead of direct line impulse.

"Now, to practically effect my proposition, I contemplate an oblong balloon, whose capacity should be but a few pounds less in ascensive power, when provided with a vertical and horizontal set of rotary inclined planes, than the burden it is to carry. Then, but a small portion of the power of a man to the horizontal planes, would cause its ascension, and a proportionate power to the vertical ones, would cause its forward progress. The steering could be effected exactly in the manner of a ship, bird, or fish. I have, also, in my head the application of a well-known, very common principle of power, little inferior to steam, which has but trifling weight, and requiring neither fuel nor fire, which could as certainly be brought into action, as that of human or any other force.

"In the same communication (June 17th, 1828), I proposed the application of this principle to the propelling of vessels, exactly as Mr. Loper has since done, efficiently in the fact, and, I believe, profitably so to himself; with the additional proposition of substituting inclined planes for the wind, instead of steam power, to move the propellers—and invited the conference of any enterprising person, whose means and perceptions might be brought to favor an experiment; but, though the communication was copied into some papers—particularly, I remember, the 'Boston Galaxy' —I never have heard a word of it since.

"I do not mean to imply that Mr. Loper's device is not intuitive with himself, for my observation and experience have informed me of the fact that two persons, or even more, widely distant and unknown to each other, may hit on the very same idea."

The plan laid down above is theoretically correct, and, were it not for the desideratum existing in the propelling power, it were worth the while to try it. Human power is insufficient for, and steam power is not adapted to, balloon navigation; there are several insuperable difficulties connected with it, to say nothing of the danger that would constantly attend its use, arising from the proximity of fire with so ignitable and explosive a substance as the gas would be that might in any way escape from the balloon and mix with the air surrounding it.

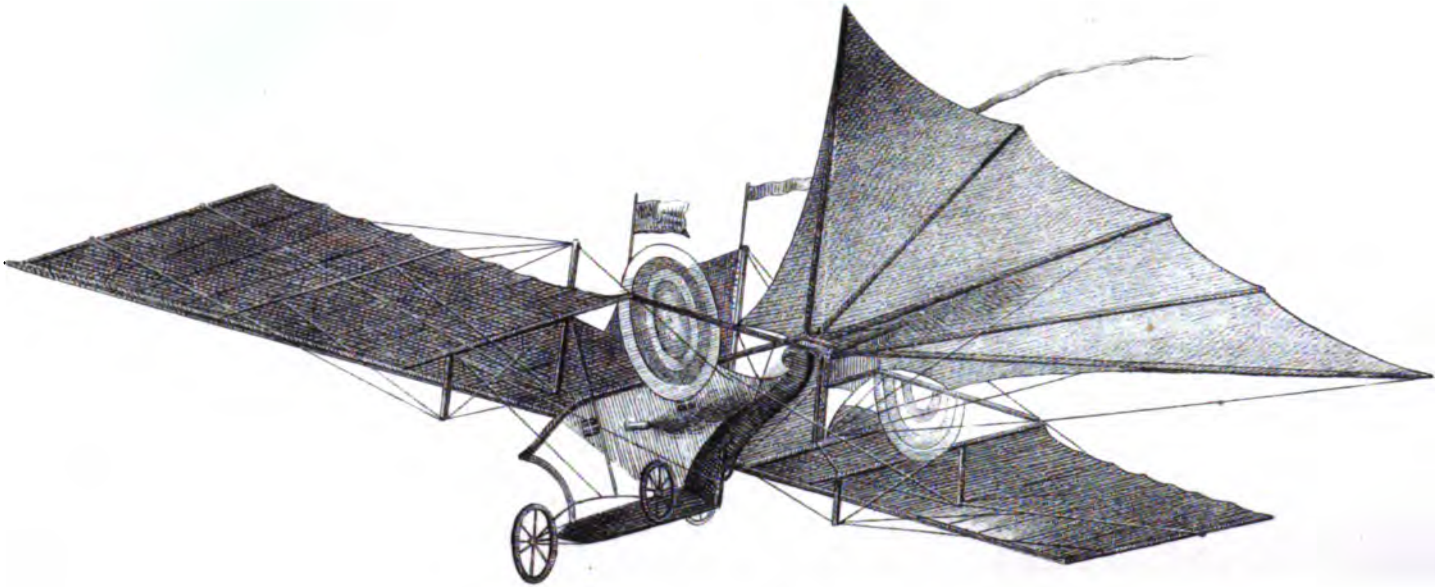
The next which is worthy of consideration we find in Henson's idea. Many persons in England were sanguine in the belief that his machine was destined to perfect the art of aerial navigation, and it was seriously contemplated to build one after his model, with which to cross the Atlantic. Indeed, it was well calculated to inspire such a belief in the mere theoretical mind; but to the practical man it at once occurs, what is to keep it from tilting over in losing its balance by a flaw of wind, or any other casualty, and thus tumbling to the ground, admitting that it could raise itself up and move forward?

The principal feature of the invention is the very great expanse of its sustaining planes, which are larger, in proportion to the weight it has to carry, than those of many birds; but if they had been still greater, they would not have sufficed of themselves to sustain their own weight, to say nothing of their machinery and cargo; surely, though slowly, they would have come to the ground. The machine advances with its front edge a little raised; the effect of which is to present its under surface to the air over which it is passing, the resistance of which, acting on it like a strong wind on the sails of a windmill, prevents the descent of the machine and its burden. The sustaining of the whole, therefore, depends upon the speed at which it is traveling through the air, and the angle at which its under surface impinges on the air in its front, and this is exactly the principle by which birds are upheld in their flight with but slight motion of their wings, and often with none.

But then this result, after the start, depends entirely on keeping up the speed, and there remains beyond that, the still more formidable difficulty of first obtaining that speed. All former attempts of this kind have failed, because no engine existed that was at once light enough and powerful enough to lift even its own weight through the air with the necessary rapidity. Mr. Henson has removed this difficulty partly, by inventing a steam engine of extreme lightness and efficiency, and partly by another and very singular device, which requires particular notice. The machine, fully prepared for flight, is started from the top of an inclined plane, in descending which, it attains a velocity necessary to sustain it in its further progress. That velocity would be gradually destroyed by the resistance of the air to the forward flight; it is, therefore, the office of the steam-engine and the vanes it actuates simply to repair the loss of velocity; it is made, therefore, only of the power and weight necessary for that small effect. Here, we apprehend, is the chief, but not the only merit and originality of Mr. Henson's invention; and to this happy thought we shall probably be indebted for the first successful attempt to traverse at will another domain of nature.

The editor of "Newton's Journal of Arts and Sciences," an excellent English periodical, speaks of it thus: "The apparatus consists of a car, containing the goods, passengers, engine, fuel, &c.; to which a rectangular frame, made of wood or bamboo cane, and covered with canvass, or oiled silk, is attached. This frame extends on either side of the car, in a similar manner to the outstretched wings of a bird; but, with this difference, that the frame is immovable. Behind the wings are two vertical fan-wheels, furnished with oblique vanes, which are intended to propel the apparatus through the air. These wheels receive motion through bands and pulleys, from a steam or other engine contained in the car. To an axis at the stern of the car, a triangular frame is attached, resembling the tail of a bird, which is also covered with canvass or oiled silk. This may be expanded or contracted at pleasure, and is moved up or down for the purpose of causing the machine to ascend or descend. Beneath the tail is a rudder for directing the course of the machine to the right or to the left; and, to facilitate the steering, a sail is stretched between two masts which rise from the car.

"The amount of canvass, or oiled silk, necessary for buoying up the machine, is stated to be equal to one square foot for each half pound weight, the whole apparatus weighing about 3000 lbs., and the area of surface spread out to support it, 4500 square feet in the two wings, and 1505 in the tail, making altogether .6000 square feet. The engine is proposed to be of from twenty-five



P. S. Duval's Steam lith. Press.

HENSON'S ÆRIAL STEAM CARRIAGE.

to thirty horse power. It is stated, in the specification, that, on launching the machine into the air, an elevated situation must be selected, and the machine allowed to run some distance down an inclined plane, for which purpose vertical wheels are attached to the bottom of the car or boat. When the machine has thus acquired a momentum, the rotary fan-wheels are put in motion to raise it into the air and propel it; the rudder appended to the car is then used for regulating its course.

"In concluding our hasty remarks on this invention, we would remind our readers that many projects of a like character have been promulgated to the world by enthusiastic projectors, all of which have fallen to the ground (we use a figure of speech, for they have never risen), from the fact of having overlooked the laws of matter, and miscalculated the powers of mechanism, in imitating the functions of animal life.

"The engraving of this machine represents the aerial steamer flying. The bat-like wing, or sail, is the tail which turns on joints; answering the same purposes as the tail of a bird; and can be depressed, elevated, contracted or expanded, at the will of the commander. The car, containing the steam engine, cargo, conductors, and passengers, in suitable compartments, is represented by windows, and three wheels upon which the carriage can run on land. Aerial goes foremost, and is a little raised: to the middle of the other is jointed the tail. The carriage is two hundred and fifty feet by thirty, and the tail is fifty feet long. The rainbow-like circular wheels are the propellers, answering to the wheels of a steamboat, and acting upon the air after the manner of a windmill. The car is seen at one side, owing to the difficulty of representing it in an engraving *underneath* the surface of the carriage, where it is located, between and below the propelling wheels."

This invention was introduced eight or nine years ago, and drew the attention and commendation of the scientific both of Europe and America. It certainly comes nearer to the construction and consequent physical action of the bird, than any that has ever preceded it. It, moreover, embraces all the most rational conceptions, and fine mechanical contrivances, without the inefficient incumbrances, of all other flying machines that have ever been brought before the public. We might go on and multiply the description of plans and models that have been suggested of late years; but as the ones we have here given seem to embrace every valuable discovered feature of mechanism, it seems useless to waste time in their further investigation. Even Messrs. Porter and Robjohn's California Balloon, which they designed should be propelled by steam applied to the Archimedes screw-wheel, is but a repetition of the suggestions made years ago. The propulsion of the spheroidal balloon by steam or any other power, applied to the windmill-like paddle wheel, was first shown by a working model, put in motion by a clock spring, by Charles Green, of England, one of the most experienced aeronauts in the world, before the Polytechnic School of London, ten or twelve years ago. By reference to the London papers of that period, a description will be found concerning it. Mr. Green has gone farther than this—he has given us a plan by which a balloon may be made to ascend and descend without expending ballast or gas, which is certainly more valuable in the art of aerial navigation than any improvements lately made. And even this idea ("kedging") is said to have been first suggested as available in balloon sailing by Baldwin, a writer on aeronautics.

CHAPTER XV.

Treatise from the "Westminster Review"—Means of propulsion—Electro-magnetism and gun-cotton—Guide rope—Various methods of keeping balloons at a certain height—Friction of guide rope applicable to steering—"Kedging."

"The problem of aerial navigation is of course not completely resolved by the invention of a machine or apparatus capable of sustaining the human body in the air. It is necessary to discover, likewise, the means of guiding or propelling such a machine in any direction. It would, perhaps, at first sight appear probable that, if means of floating in the air be discovered, a method of propulsion could be readily found; yet it has proved in practice a far more difficult attempt than had, at first, been imagined; and the numerous schemes for effecting this object have all proved abortive, or been attended with success so insignificant as not to warrant the further prosecution of them. The balloon invented, the art of guiding or propelling it appears thus to be almost as far from our grasp, and as distant of attainment, as ever.

"Since the invention of the gas balloon, by M. Charles, of Paris, but few improvements of importance have been made in it; and, as might be foreseen from the original simplicity of the invention, what improvements have been made, are not improvements in the principle, but in minor matters of detail. The most important improvement since introduced, is one effected in the early part of the present century, by Mr. Green, well known for the many successful public ascents which he has since made. This improvement consists in the use of coal gas instead of pure hydrogen, which latter gas was employed in the ascents of M. Charles, and the subsequent ones of Lunardi, Garnerin, and other aeronauts.

"One of the principal advantages arising from the employment of coal gas is economy, the saving of expenses being very great; at the same time, from the greater density of the gas, its use entails this disadvantage, that the balloon is required to be of somewhat larger dimensions than when pure hydrogen is employed for inflation. The original expense of construction is thus increased, but the disadvantage of the greater cost and size of the balloon is more than counterbalanced by the economy and convenience attending the use of coal gas; and, what is of great importance if balloons are eventually to become of practical utility, the period which a balloon retains its ascending power is considerably prolonged, when coal gas is substituted for pure hydrogen.

"Since the introduction of the use of coal gas in aeronautics, but few, or rather, perhaps, we ought to say no improvements in the construction of balloons have been made; minor improvements have indeed been made in the form and arrangements of some parts of the machine, or apparatus connected with it, such as the ingenious method of liberating the balloon employed by Mr. Green, whom we have already mentioned; but these are all simple contrivances of detail, which in no respect alter the principle of the machine.

"With the invention of the balloon, we had then obtained the means of floating in the air, and acquired possession of a contrivance for this purpose; which, except its inability to support very great weights, left but little to be desired, when considered as destined merely to support the human body in the air, and to move freely with the wind. But the employment of such a contrivance can scarcely be called aerial navigation; and, in fact, only half the work had been done; the ship for navigating the air had been invented; the art of sailing is still unknown. We can scarcely consider ourselves to have succeeded in discovering the art of aerial navigation until the aeronaut has at his command the means of varying the elevation of the balloon above the earth, and of causing it to move in any horizontal direction, at will. Two methods of effecting this naturally suggest themselves; indeed, the art of aerial navigation may be considered (as that of ocean navigation now generally is) as divided into two great and distinct branches; the one, comprising the manner of directing the machine by the agency of the wind itself in any direction, either coincident with or different from that of the wind; the other, the employment of artificial means of propulsion, such as propellers driven by steam engines, or machinery of a similar nature. Of the attainment of a practically useful method of propelling balloons by the motive power of steam, we fear there is little hope; and were the attention of projectors directed to a method of sailing balloons, rather than propelling them, it is probable some useful practical progress might soon be made in the art of aerial navigation. Attempts at guiding balloons have indeed been made; but, being ill directed, have always failed; and, in fact, the application of the steam engine to locomotion not having been made at the time of the invention of balloons, all the early attempts at guiding balloons, or increasing their speed, were directed by the analogy, real or supposed, of a balloon and a sailing vessel. The supposed identity of the two cases led immediately to the trial of sails and rudders applied to balloons; the experimentalists not perceiving the considerable and important difference existing between the two—a balloon and a ship—appear to have fancied that the two cases differed merely in that of the balloon floating in a medium of far less density than water. The similarity of the two cases is, however, apparent rather than real. In the eagerness of the attempt, it was entirely overlooked that whilst the balloon, entirely surrounded by and immersed in the fluid which supports it, moves necessarily at the same rate as the current of air in which it happens to be, a vessel floating on the surface of the water is impelled by the force of the air, which, moving at a much greater velocity than any current, either in the river or the ocean, has, notwithstanding its much less density, sufficient power to give motion to the vessel. Sails and rudders, then, when applied to balloons, were found useless; the first did not increase the speed of the balloon, the second had no effect in guiding it. Sails were, of course, useless, since there was no wind to fill them—a balloon moving as fast as the wind; and for the same reason, there being no current, the rudder had no action on the direction of the motion.

"The more recent attempts made of late years have almost invariably been founded on schemes for propelling balloons, and, in a great number of these, the employment of the steam engine is a principal feature. The objections to the employment of this motive power, even if it should be found possible to avail ourselves of the force of steam for this purpose, would probably prove of such force as to prevent its introduction to any extent. It may, no doubt, be urged that, in a medium of so small a density as air, the actual force required to propel a balloon would be very small, and that this being the case, the size and weight of the machinery necessary to impel a balloon need not be very considerable, and that, therefore, it would be found possible to construct balloons of sufficient size and ascending power to carry the necessary machine. But, were it even so, the necessity there would be of either relinquishing the use of the propeller after a very short period, or of descending to obtain supplies of fuel and water, would be found to render its practical application of but little value. If it also be remembered that to work a steam engine it requires not only an engine and boiler, but a heavy weight of water and fuel, even if the engine work but for a very short time, and also engine men and stokers to work the machinery and feed the fires, the uselessness of the attempt is so evident as to render numerical calculations unnecessary for exposing its fallacy. The lightest form of marine steam engine in use weighs about thirteen hundred weight per horse power, and when to this we add the weight of fuel and water contained in the boiler, and that of the men necessary for attending the machinery, we arrive at a sum total for the weight, whatever horse power we may assume as necessary, entirely beyond the power of any balloon to support. For, though we may imagine a balloon of such vast dimensions as to be able to support such a weight, yet the construction of such a balloon would be difficult, and its inflation almost impossible.

"But, hereafter, one means of obtaining motive power may be discovered which will enable us to dispense with the cumbersome appendage of a steam boiler, and the weight of fuel and water necessary for it. Electro-magnetism may, perhaps, stand us here in good stead; but, at the present moment, the recently discovered gun-cotton offers, perhaps, the best hopes of success. The enormous force of this substance, compared with its weight and the space it occupies, the abolition of the boiler and all fuel which it will effect, and the fact of no water, either for feed or condensation being required, are advantages which make us look forward to a trial of gun-cotton as offering a prospect of greater success than has hitherto attended attempts at balloon propulsion. Gun-cotton might be tried, probably with some effect, on the recoil principle of the rocket, and the fumific impeller of Mr. Gordon, as well as with machinery similar to the ordinary steam engine, such as has recently been patented by Mr. Talbot. The force of steam not being in this case applicable as a propelling power, if that of gun-cotton should not be found available, we must seek in another direction for a motive power, which, with a small weight, gives an intense force. The great object of the inventor will evidently be to get rid of a heavy incumbrance, such as a steam boiler, and to confine his machine within the most narrow limits possible as to space and weight. The use of gun-cotton in lieu of steam, would certainly reduce the size and weight of the machinery, as far as we can reasonably hope to reduce it. Our propelling machinery would then, in short, be a steam engine working without water, without a boiler, and with but a very small weight of fuel; but, until this substance has been successfully applied as a motive power, its application to ballooning must, of course, be mere conjecture.

" There can be no doubt that, if a motive power fit for the purpose could be found, some form of propeller would soon be invented capable of applying this power, with good effect, in the propulsion of balloons. The numerous experiments which have been made during the last few years with submerged propellers applied to steam vessels, make it certain that a similar form of propeller might be used for balloons, with a fair chance of a successful result, if only a moderate velocity be required. We have, ourselves, seen a model balloon furnished with a screw propeller, worked by clock-work, perform in a satisfactory manner in a small room, the air being still. The employment of a propelling power applied to the car of a balloon would, however, experience a difficulty of a peculiar nature, which presents itself in all balloon experiments; this is a constant, though slow, rotation of a balloon round its vertical axis. The use of the guide-rope, which we shall presently describe, almost, if not entirely, destroys the tendency to rotation; but, one effect of the guide-rope is to retard the motion of the balloon, while the object of the employment of a propelling force is, of course, to increase the velocity of the balloon, so that the cotemporaneous employment of the propelling force and the guide-rope is scarcely feasible; but, until, by some alteration in the form of balloons, or by the application of some mechanical contrivance destined to that effect, the tendency of a balloon to rotate round its vertical axis be destroyed, the application of propelling machinery to balloons can be followed but by little or no useful effect.

" The want of success attending the early attempts at guiding balloons, appears to have deterred adventurers from repeating these experiments, or devising new methods for effecting this object; and, since the beginning of the present century, nothing of practical utility has been tried. However, Mr. C. Green, whom we have already had occasion to mention, has broached an idea which appears to be in the right direction, and which will, possibly, when modified, be found to be feasible. Mr. Green having remarked, during his numerous balloon voyages, that at various heights above the earth he met with currents of air which carried him in a direction different from that in which the wind was blowing at the time of starting, conceived the idea, if it be possible to keep a balloon at a constant elevation above the surface of the earth, that advantage might be taken of this circumstance, for; by increasing or diminishing the altitude of the balloon, a current of air might be found to carry the aeronaut in any direction he might desire. It has, indeed, been long known that the wind, observed at the surface of the earth, does not blow in the same direction with the current of air moving at some distance from the earth. This phenomenon occurs not only in our latitudes, but also in the regions of the trade-winds; and several observers, amongst them Sir James Ross, in his recent voyage, have noticed, when in the trades, small clouds moving at a considerable height above the sea, in a direction contrary to that of the trade-winds. It is obvious that, if it be true that, at some height or other above the earth, we may find a wind blowing in any given direction, and supposing we can cause the balloon to remain invariably at the same height, we might be enabled to move a balloon in any direction, merely by ascending or descending until a current of air having the required direction is met with.

"Various methods of causing the balloon to remain at an invariable height may, doubtless, be supposed; but the one actually in use, namely, that of discharging gas or ballast according as it may be necessary to check a tendency of the balloon to rise or fall, is of very limited application, for the quantity of ballast and gas which can be employed in this manner is very small. The power of varying the elevation, or remaining at the same height, would be greatly extended by the use of condensed or liquefied gas; a small receiver containing liquid coal gas, might be taken up in the car, and being connected with the balloon by a tube and stopcock, the aeronaut would be able, by the simple opening of the stopcock, to permit the entrance into the balloon of a large quantity of gas. There would undoubtedly be a few practical difficulties in its application, but none such as could not be readily overcome; but the danger attending the use of gas in this form is but slight; liquefied gas having been in common use for some years past, for lighting apartments and railway carriages in France.

"Mr. Green, however, proposes Mr. Baldwin's method, which is very different from the above. He supposes the aeronaut furnished with a rope of sufficient length to reach from the balloon, when in the desired current of air, to the earth; one portion of the rope resting on and trailing along the surface of the earth or sea, as the case may be, while the other end is attached to the balloon or car. If the balloon, from the effects of the sun's rays on it, rise to a greater elevation, a corresponding length of rope will be raised off the surface of the ground and supported in the air, and in the same way, if the balloon sink, an additional length of rope will be plunged in the water or drag along the earth. The result will be that, in the one case, the same effect will be produced as if an additional quantity of ballast were added to, or a small volume of gas allowed to escape from, the balloon; in the other, the effect will be similar to that of the discharge of ballast from the balloon. It is evident that by this contrivance the balloon will remain at nearly the same height from the ground, the effect of any expansion or contraction of the gas created by increase or decrease of the temperature of the surrounding air being counteracted by the alteration in the weight which the balloon has to support, and that without any loss of either ballast or gas. This method, however, could scarcely be practicable, except at sea, on account of the damage and difficulty its employment would occasion by the entanglement of the rope in trees and buildings; but at sea no difficulty arising from these circumstances could be experienced, and the experiment is certainly well worth a trial. At great elevations above the earth, the weight of the rope would also become so considerable as to require for its support a large portion of the ascending power of any balloon.

"One thing is clear, that the friction of the rope on the earth or in the water, would occasion a degree of resistance sufficient to retard in some degree the speed of the balloon; and this would lead us to hope that this plan being adopted, it would be found possible to guide or steer balloons. We have already observed, that to guide or steer balloons, it will be necessary to find out some method of creating a relative velocity between the balloon and the wind which impels it; or, in other words, we must arrange matters so that the balloon move either slower or more rapidly than the wind. Now this is effected by the proposed guide-rope of Mr. Green; and we may observe, that sailors are sometimes compelled to resort to a similar artifice in order to obtain steerage-way on a vessel.

"This artifice in navigation is termed 'kedging,' and is employed when vessels are floating down streams or rivers, when there is no wind. Under such circumstances, a vessel would be in constant danger of being run on shore, unless steerage-way could be got on the vessel. This is effected in the following manner: It is well known that an anchor holds the ground more or less firmly, according as its distance from the vessel is greater or less; and, when the anchor is immediately under the ship's bow, it has very little or no hold. Now, supposing a vessel be in a tide-way with no sails set, to obtain steerage-way, the anchor is allowed to trail along the ground, under the bows of the vessel, the cable being hove down until nearly vertical; and the resistance thus opposed to the motion of the vessel through the water, sufficiently great to enable the vessel to be steered.

"The artifice above, briefly described, evidently bears a striking resemblance to the guide-rope of Mr. Green, and we think that an attempt at steering balloons, made in conjunction with the use of the guide-rope, would be successful. Of course some practical difficulties would be found to exist, and the form and arrangement of the steering apparatus, would be a subject for great consideration. Some difficulty would also be met with from the rotation of the balloon on its vertical axis.

"At sea, where this idea holds out great hopes of success, the lower end of the guide-rope should be attached to a small boat, or float, which would increase the resistance, and give additional steerage-way.

"The difficulties of steering balloons would then be found, we think, to be far from insuperable. The rotation of a balloon about its vertical axis would likewise be found a considerable obstacle to the use of any propelling power, since the rotary motion of the balloon would cause the direction of the propelling force to change at each instant. A balloon always rotates in this manner, but its rotation is slow, and the fact is not at once perceptible, and only apparent on regarding fixedly an object, such as a cloud, at some distance from the spectator, when the position of the observer is soon found to change. It is possible that, were a form other than the spherical one, usually adopted, given to a balloon, this motion of rotation might be very much diminished, if not altogether avoided."

CHAPTER XVI.

Rotation of balloons considered—Shape of balloons, also—Their navigation demonstrable—Method set forth—Facility of crossing the Atlantic—Effect of experiment considered—Air and water craft—California air steamer—Comments on it—"Difficulty of aerial navigation"—Pro and con—Its dangers considered.

The preceding account, which we have quoted from the "Westminster Review," seems to cover the whole ground of the theory of balloon sailing and balloon steering. The value of its ideas and suggestions is enhanced by the fact, that what it contemplates as serious obstacles to the perfection of balloon navigation, are, to the practical aeronaut, but minor difficulties. The rotary motion of the balloon, while sailing quiescently in the air-current, is the effect of so slight a cause, that its reality, under the present system of aeronautics, presents no formidable obstacle to the perfection of aerial navigation. This rotation is attributable to two causes—the shape of the balloon and the undulatory motion of the air-currents. The position of the balloon, when floating in the air-current, while it is in equilibrio with the surrounding atmosphere, may be justly compared, in regard to its motion round its vertical axis, to a similar shaped vessel with a string fastened to its upper axis and suspended from the ceiling of a room. In the latter case, the vessel should have gravity enough to merely hang down, in order properly to illustrate the question. It will thus be perceived how very slight must be the wave of atmosphere to put it in motion, poised as it is, in either case, upon its centre of gravity. In the case of the suspended vessel, it would have to overcome the friction of the string by which it was hanging, and would consequently require more force to make it vibrate on its axis, than it would with the balloon, which, while sailing free in the air, would not have to encounter that part of the friction. Now, it is evident that the effect of so slight a cause as that which gives rotary motion to a balloon, would be entirely neutralized by any propelling force that would move it faster than the air-current; as, in such case, there must necessarily be a rudder, which would keep the machine *fore and aft* with its line of direction, the same as a steamboat or ship would be, when propelled along, and faster than the current in which either of them might be sailing. I have, while sailing in the air-current, reversed the motion of the balloon round its vertical axis, by simply using a palm-leaf fan. There is, however, connected with this part of the subject, another circumstance worthy of consideration. It is while the balloon is ascending and descending from one current into another. In such case, the effect of rotation and counter rotation is of course more violent than when the balloon is sailing quiescently in the air-current; and it is similar to that which a ship experiences when sailing through a bay and coming suddenly across a current dashing down a river into the bay. But even this circumstance presents no greater barrier to the management of a balloon while being propelled by the aid of artificial motive power, than does the case just mentioned to the ship's management.

It has been demonstrated, that a balloon of a spheroidal shape, moving forward with its longer axis in a horizontal position, and propelled by a motive power applied to windmill-shaped wheels, is not liable, or at least not much disturbed, by a tendency to rotary motion. And even a globular-shaped balloon would be free from such disturbance when propelled forward, and having a rudder to guide it. But, of course, an oblong shape—which comes nearer the shape of a bird or a fish—is best adapted to the principle of steering or guiding; while the globular shape, on the other hand, is best adapted to the method of seeking the air-currents which are to *waft* it to its destination. Here are two principles, by which aerial navigation may be accomplished in a useful manner. By a combination of the two principles, it is within the present known province of mechanical contrivance; and requires nothing more than the effort to put it in motion. While on this subject, let us consider the means of its consummation. A balloon, fifty by a hundred feet, of a spheroidal shape, would be capable of carrying 6000 pounds independent of its own weight, and a due allowance for expansion of the gas. This would enable us to carry a car, supplied with an engine to be worked with gun-cotton, sufficiently powerful to propel the balloon with a speed of eighty miles per hour in a calm atmosphere, forty miles per hour against a wind of a velocity of forty miles per hour, and so on in the same ratio against winds of greater or lesser velocities. In addition to the engine, wheels, and rudder, the balloon would be capable of carrying from 1500 to 2000 pounds of ballast. Now, with an aerial ship thus provided, I would have no more hesitation to undertake a trip across the Atlantic Ocean, than to embark for that destiny in the most approved steamship now plying between the ports of New York and Liverpool. Indeed, the engine would only be required to make steerage way, so as to make the *exact* point of destination; for, the main part of the voyage may be certainly accomplished by seeking the proper currents that will *waft* the vessel in its destined direction. The engine could be, moreover, employed as a means of elevating or lowering the balloon, by having a screw wheel adapted to that purpose, and by such means enable us to seek the proper or most advantageous current, without expending any gas or ballast while in search of it.

Now, an experiment of this kind is really wanted. It is wanted for two important reasons; one is, to demonstrate positively and in reality, that aerial navigation is so far practicable as to enable us to sail from New York to Liverpool with a balloon, and that, too, in less than half the time it requires the best ocean steamers to accomplish the same. The other reason is, to draw the attention of the community at large towards the improvement of the art, which will follow just as surely as the experiment will be accomplished.

Steam, the agent which has revolutionized the moral and commercial world within the present century, would, in all human probability, be to this day yet what it was in the hands of Savary and Newcomen, had not a Fulton demonstrated its utility by actually building a steamboat, and propelling it up the Hudson River at the rate of four miles per hour. So with aerial navigation—something more than mere theorizing and simple ascents with balloons is wanting, to bring it to that state of perfection which art, science, and the genius of our race require of it. So far, however, our modern projectors of aerial machinery, all seem to have overstepped the mark. The few who have actually been engaged in it have rather attempted too much, and therefore failed in their designs, instead of doing what was within their reach, and thereby establishing that confidence in the community, which is so necessary to the attainment of a high perfection in anything that concerns the general welfare of a nation. Miscarriages in projects connected with an advancing art are more detrimental to its progress than if no experiments were made at all; while, on the other hand, success in an experiment which gives the slightest evidence of improvement is generally followed by rapidly increasing accessions. On this account, it were better if the friends and promoters of this art would confine their experiments within the range of what is more certain of success, than to overleap the expectation of moderate advance, and thereby lose the time and labor devoted to the subject, which, in the end, brings distrust instead of encouragement.

In attempting too much, we do not simply run the risk of being defeated in the end; but we also bring down upon the projects in such cases, theoretical demonstrations from scientific sources, that are strongly detrimental to a vigorous pursuit of the subject. Such has been the case in regard to projects lately suggested in some of our large cities, concerning aerial navigation. Not many years ago, it was proposed in the city of New York to form a company to navigate the Hudson River between the above-named city and Albany, by a combination of water and air craft machinery. It was to consist of a balloon and a steamboat. The balloon was to be oblong or spindle shaped, of the same length as the steamboat, and was to be of such power as to buoy up a less weight than the boat, so much less, as to leave the boat draw water sufficient to make her steerable, and for her propelling wheels to take effect in the water. Thus combined, the steamboat hanging underneath the balloon, drawing very little water, the wheels put in rapid motion, it was to go up or down the North River with a velocity of not less than a hundred miles per hour.

Now, all this appeared very feasible and interesting in theory, and a great many sensible people believed it would go into operation; but, to the practical mind, it at once proved its own futility. In a calm atmosphere, and on a straight river, this might be done; but in the ordinary and natural requirements of transportation and its circumstances, it promised no usefulness, nor even experimental success.

In later times, and in the same place, when half the population of our country was infatuated with the gold romance of California, it was proposed to build a balloon with which to carry passengers to the gold regions of California at the rate of two hundred miles per hour. A model of the machine was exhibited in New York and in Philadelphia. It was simply a spheroidal or spindle-shaped balloon, rigged with a pair of propeller wheels and rudder, and a steam engine for propelling power. The exhibition of this model created a considerable sensation in the minds of the credulous, and it was asserted at the time that many persons engaged passage in the contemplated "Aerial Steamer." Whether it was seriously intended by these projectors to build one on a large scale, time, thus far, has not yet positively developed; although, it was stated in a respectable journal of New York city, in the year 1849, that the machine was actually in course of construction, and the steam engine was finished.

Had these projectors gone on from their miniature model, to the erection of one capable of carrying one or two persons, in order to prove its practicability on a larger scale, there might have been reason to believe that they harbored an idea of its general usefulness. But when the project embraced at once so magnificent a scheme, as that contemplated in the swooping strides towards the modern *El Dorado*, with a cargo of a hundred gold hunters, it seemed too much for sober-minded people. And, as we stated before, it brought upon itself philosophical criticism and scientific condemnation, and with that, a good share of opposition to the hopes and expectations of aerial navigation in any shape.

The "Scientific American," one of the best journals of its kind then existing in the country, published in the city of New York, made frequent allusions to the subject of aerial navigation, as well as to all matters connected with the progress of the material world, and, from the assumptions contemplated in the California project just mentioned, published the following article under the head of "The Difficulty of Navigating the Air." It says: "No body can float in the air unless it be 800 times lighter than water; such a body, therefore, must of course carry 800 times less power than might be used in a steamboat. But the utmost power that a steamboat can carry will not enable it to make the least headway against wind blowing 200 miles per hour. How then is it possible for a body of 800 times less power to make any headway against even a wind blowing three miles an hour?

"In navigating the air, we can obtain no fulcrum but the air itself, and that is yielding, and but a small portion of even the power which can be carried could prove effective.

"If a body, so comparatively solid as water, causes a loss of power, the loss must be vastly greater in a body 800 times lighter and exceedingly elastic. When to all this we add 800 times less power than a steamboat, and at the same time bear in mind the further fact that a steamboat cannot make the least headway against wind blowing 200 miles an hour—it is no go."

Seeing the effect of such reasoning, coming, as it did, from a purely scientific and highly respectable journal, the author of this work, as an ardent laborer in the cause of improvement, felt it his duty to notice the above hypothesis in the following brief manner:—

Gentlemen: In the second number of the present volume of your journal, you have an article under the head of 'The Difficulty of Navigating the Air.' In it you correctly assume that a body must be 800 times lighter than water before it can float in the air, and that such a body, therefore, must carry 800 times less power than a steamboat. You then go on and state that a steamboat cannot make any headway against a wind blowing 200 hundred miles per hour. Granted. The part of the boat above the water is opposed by the wind—the part below, or in the water, is against the opposing *current* of water, caused by the wind, which is much more opposing than the wind would be of itself, if blowing against the hull of the boat directly. In the case of the water, acted on by the wind, it is an *accumulating* force, increased by the duration of the blast and extent of its impact upon the water. But it is even so as you have stated. You then say, 'How is it possible for a body of 800 times less power to make any headway against even a gentle breeze blowing three miles an hour?' And from the whole calculation you make in the aforesaid article, you conclude that aerial navigation 'is no go.'

Your paper is intended to promote the arts and sciences, and your opinion on any subject, being its editors, carries with it weight, and should, therefore, be open to a fair analysis. Now, if your premises in the question were firm and invariable, the conclusions could hardly be shaken. Your hurricane would, indeed, blow all aerial machinery its own way, with a velocity *exactly* equal to its own (I have experienced this), and it would, moreover, wreck and founder any ship or steamboat in the water caught in its track. Not so, however, with aerial machinery! The air-craft has but one medium, the water-craft has two; hence the latter's destruction, arising from the great disparity of density in the two mediums, and the former's safety from moving in the simple element. Such a wind, so far from injuring a balloon, would only drive it completely round the world in five days, if it continued that long. Now, the aerial ship has an advantage, compared with the water ship, that is seldom considered. It can *surmount*, or *dodge*, the 'no go' barrier in your premises—the steamboat can't. It is not necessary, in aerial navigation, to go right against the wind; nature is very profuse in its variety of atmospherical currents, within two miles above the level of the sea. The greatest obstacle to the perfection of aerial navigation is in the loss of buoyant power required in rising and falling into the currents that will waft the vessel towards its port of destination. I am not theorizing when I say that nature is profuse in its variety of currents; I know it from the experience of over a hundred aerial excursions. By the aid of these contrary and various currents, I have avoided the necessity of descending into rivers, forests, lakes, seas, and bays. The uppermost current I have always found to blow from west to east. While aloft, I have, within the *visible* length of a twine string suspended from the car, seen the effects of two currents besides the one that moved the balloon. These strings were 500 feet long. You may often see, as you no doubt have seen, two, three, and four different currents of air within the range of the cloud region, when clouds exist. I have found these various currents just as numerous in a perfectly clear atmosphere. The greatest desideratum, in aerial navigation, is a power adaptable to raising and lowering the balloon, without expending any of its buoyant gas. Steam, I think, is not adaptable to its being made a *common* useful art. It would do for a demonstrable purpose. But the progress of improvement may yet give us a power-agent adaptable to this art, if we should fail to contrive a means by which a balloon may be made to rise and fall by the principle of expansion and contraction.

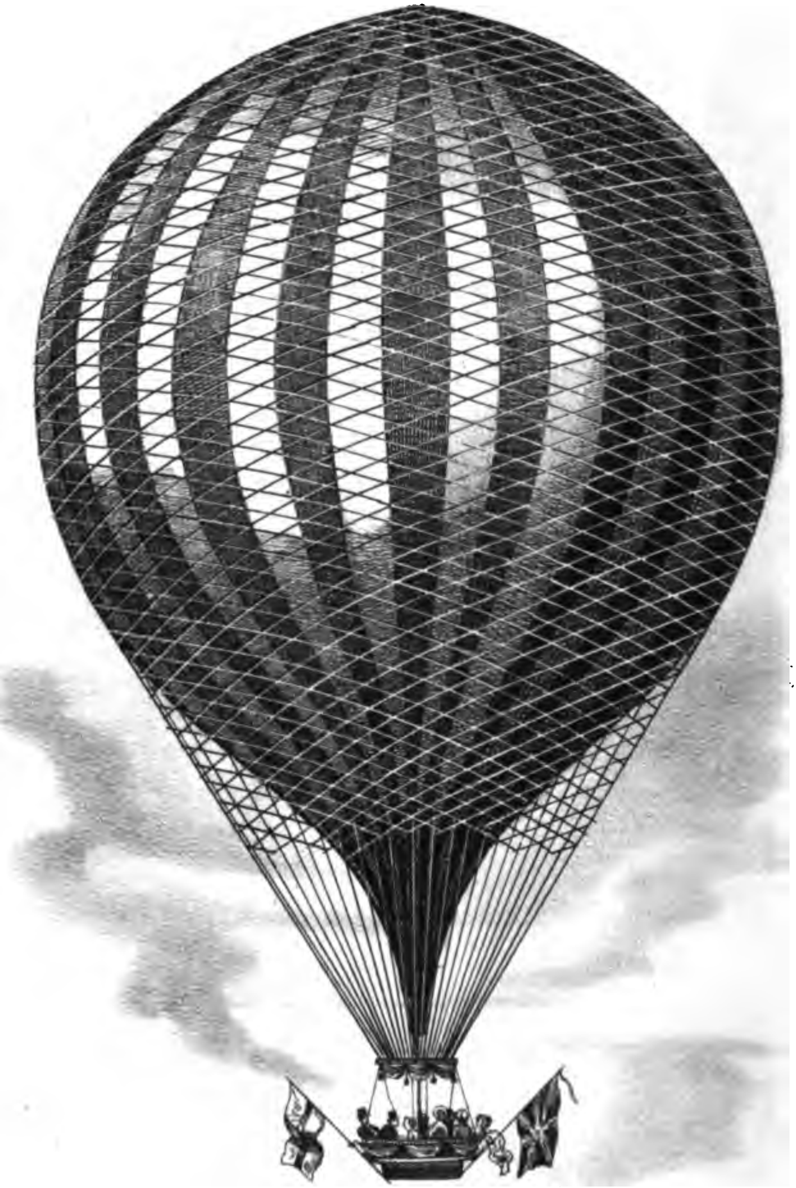
Franklin said the child must learn to walk before it can run, in allusion to aeronautics; and, as this child lay in the womb of science over two thousand years before it was born (it was sought after all that time by many ingenious persons), it is certainly doing very well, considering its infant state. A subject like this, calculated, when perfected, to bring within the space of a few weeks the practicability of exploring the whole circumference of the globe, must have its time,—that time is fast approaching; but it wants encouragement, especially by the developing powers,—the scientific press.

The natural elements, so far from presenting barriers and obstacles, as they do to a great extent in ocean navigation, seem to be peculiarly inviting to aerial navigation. The almost universal opinion, and to a great extent among really scientific men, that aerial navigation cannot be turned to a generally useful account, is almost as prevalent as the opinion that aerial voyages are extremely dangerous, and is just as wrongly founded, in my humble opinion.

The foregoing article was published in the New York "Scientific American," and drew from its editors the following complimentary notice. [" The above communication from Mr. Wise is just such a one as we like. It is reasonable, and contains practical information. His opinions respecting steam as an aerial propellant accords with our own, and as we have expressed them on the subject in our last volume. There is another thing, besides the discovery of a more compact power, which would greatly facilitate economical balloon navigation, namely, a more buoyant, cheaper gas than hydrogen. A body of great magnitude is not easily managed—the whole experience of ballooning proves this. We all know that balloons can ascend, float, and move in the atmosphere, and have been propelled by the Roberts, in Paris. These things are not the subject of discussion. It is the practicability of propelling balloons through the atmosphere as steam vessels on the ocean. There is no man to whom we can more confidently look for a correct account of the economical establishment of aerial navigation than Mr. Wise. We would be content with a balloon speed of ten miles per hour, if the balloon could be perfectly controlled by the aeronaut, as a steed is by its rider.

" As it respects the last paragraph of the above letter, we must say that the whole history of ballooning, to scientific men, is full of facts, affording just grounds for their opinion, that is, respecting its danger. Within the past three months, one aerial navigator lost his life in England; Vardalle barely escaped with his in our city; and it was certainly a most wonderful escape of the celebrated Mr. Green, in one of his late ascents in London. The subject of aerial navigation has been before the scientific world for sixty-seven years, and we know of no practical improvements that have been made in it since the days of the French Consulate; while during that period, steam navigation, and the science of electricity, and other sciences, have advanced with giant strides; yet for all this, we never have, and never will ridicule experiments in aerial navigation. We have hopes like those of our correspondent; but so far as it regarded the balloon excitement that was raised about going to California at the rate of two hundred miles per hour, we deemed it our duty to expose the sham, although believed by thousands, and the results have faithfully borne us out in our predictions—yea, in every word."]

Now concerning the danger of ballooning, I still say there is no just ground for its apprehension. In reference to the cases just mentioned, it should be recollected that the one which



P. S. Duval's Steam lith Press.

THE VAUXHALL BALLOON.

proved fatal to the aeronaut in England, was more from the cause of imprudence, than the intrinsic peril of ballooning. The balloon and aeronaut were both drifted on to the beach soon after their descent; thus showing that, if the individual had trusted himself to the aid of his machinery, instead of, as may be reasonably supposed he did, swimming to shore, his life would have been saved. In the case of Verdalle, it must be remembered that he used a rarefied-air balloon, a contrivance long ago abandoned by scientific men on account of its inutility. As to the case of Mr. Green, it is of a kind that has so frequently happened to aeronauts without any serious consequences, that it is scarcely to be counted a peril. Moreover, there has never yet been a fatal accident in ballooning in the United States, notwithstanding many hundreds of ascensions have been made. This latter fact is a strong argument in favor of the non-danger of ballooning, when practiced by ordinarily skillful persons. If we had not the mathematical science of the art to prove that it is as simple and as safe as any other mode of travel or conveyance, this fact alone, the result of many hundred voyages, would indubitably establish the truth of what has been said of its safety.

CHAPTER XVII.

Letter from the veteran aeronaut Green—The Vauxhall balloon—Account of it from "the Mirror"—First ascent with it, nine persons went up—Green's narrative of the voyage—The enterprise—Its advantages—Cost of Vauxhall balloon.

During the early part of last fall, when I had determined to complete this work during the winter, I wrote to the veteran aeronaut, Mr. Charles Green, of London, for an account of his voyage from the English metropolis to Germany, as I had failed to find it in our libraries. Just as the book was getting ready for the press, I was fortunate enough in getting from that gentleman a package enclosing the account written for, as well as several other papers too valuable to be omitted in this edition of the work. To show the lively interest this celebrated aerial navigator still exhibits in the art, a part of his letter may be quoted:—

Highgate, Dec. 7th, 1849.

Mr. John Wise:

Esteemed Sir—Having only this day returned from the Continent, your favor has just come to hand, which I much regret, as I fear this will reach you too late to be of service for your work.

Herewith you will receive the only copy I have of the trip to Germany; likewise all I can lay my hand on relative to Mr. Cocking's fatal parachute descent. I have a numerous collection of articles on aerostation, with many duplicates, some of which, in the event of your having a second edition of your work, might be of service; but which at present are much confused and mislaid, by my preparations for removal to a new residence after Christmas.

I am convinced much may be done by the aid of propellers, not only by causing the balloon to ascend or descend without discharging gas or ballast, but in varying its direction in a tranquil atmosphere, which I have often experienced within a mile of the earth during the prevalence of a strong wind at its surface.

I likewise consider a guide-line of gutta percha, with compensating appendages as used by me for land or water, indispensably necessary to the performance of long voyages.

The accident you allude to was in a great measure a newspaper affair, which arose from my assistant suffering the escape of too much gas as it expanded in the ascent—the balloon being quite distended on leaving the earth.

I am, esteemed sir, your sincere well-wisher,

CHARLES GREEN.

(From the "London Mirror" of the 17th of September, 1836.)

THE VAUXHALL BALLOON.

"Aeronautics, or ballooning, has of late years attracted a very considerable portion of public curiosity. The early experiments in the science were fraught with uncertainty and danger, as every outline of its history narrates; from Roger Bacon's 'machine for flying,' to poor Garnerin's perilous voyage of three hundred miles. The first balloons, as the reader may recollect, were inflated with heated or rarefied air. Next, hydrogen, the lightest gas known, was substituted for the heated air, the result of which application proved a greater impetus than the science had hitherto received. Indeed, the first ascent in a balloon filled with hydrogen gas, made in 1783, must still be regarded as the most important practical improvement in aeronautics.

"Nevertheless, with this grand advance, the balloon has unfortunately proved but an abortive instrument in the hands of science. Its construction, at all times expensive, was, from the above period till within these fifteen years, too costly to reward aeronauts, especially as their labors led to no result beyond that of an exhibition of skill to gratify curiosity. Hydrogen gas, though a successful substitute, was somewhat too costly for mere amusement. Besides, there was some uncertainty in its production in sufficient volume to inflate large balloons. This uncertainty often led to the disappointment of crowds assembled to witness balloon ascents, and altogether threw discredit upon persons who professed to be competent to insure success. Hence the doubt and incredulity with which, more or less, the balloon announcements were received just previous to the year 1821.

"About this period, Mr. Green (the architect of the balloon we are about to describe), had first turned his attention to aeronautics. In his early experiments, 'seeing the great expense, difficulty, and inconvenience of using pure hydrogen gas, he conceived the possibility of substituting carburetted hydrogen, or coal gas, such as is used for illumination;' and proved the truth of his theory by ascending with his balloon inflated with coal gas, from the Green Park, on the day of the coronation of the late King George IV.; and Mr. Green has since shown the efficiency of his improvement in 220 ascents from the metropolis and the various provinces: he is now, therefore, an air-beaten sailor; and has encountered many an ill wind in gathering experience and success to qualify him for more extensive labors.

"From the year 1821, therefore, 'the use of pure hydrogen has been almost, if not entirely discontinued, the expense of generating it being six times greater than that of coal gas. But the specific gravity of coal gas being considerably greater than that of hydrogen, it gives a balloon a much smaller ascending power; and the quality of coal used, and the method employed by different gas companies in its manufacture, are so various (the specific gravity having been found to vary from 340 to 790), that it was impossible to ascertain exactly what would be the power of a balloon inflated with it.' The balloons in which Mr. Green had hitherto ascended were of such small dimensions as not to allow scientific men to take with them sufficient apparatus for making experiments, which circumstance Mr. Green considers to have caused balloons generally, to be regarded as mere objects of public exhibition. In some measure, therefore, to establish the utility of aeronautics, Mr. Green proposed to construct a balloon three times as large as any one in which he had ascended; in which project he was joined by the proprietors of Vauxhall Gardens.

"Our anxiety to introduce this new balloon early to the reader led us to apply for permission to inspect the machine in the progress of construction. The application was answered by a courteous invitation to the Garden; and thither, about a week since, we proceeded on the interesting inquiry. The morning was wet, plashy, with clouds and sunshine to feed reflection; for, of the truth, in Vauxhall Gardens, in such weather, one may suck 'melancholy from a song.'

"We reached the building wherein was *the balloon;* and which was originally the saloon wherein the Pandean Band were wont to discourse on their mellifluous pipes. Mythology and the balloon were no bad associates. Here, half prostrate on the flooring, lay the huge leviathan of silk, the bag nearly half inflated with the atmosphere, the valve aperture at the top, and the opening at the neck, being closed with wooden lids. Here, too, we met Mr. Green, in excellent spirits on having nearly completed his balloon, after 'many months of anxious labor,' and in pleasant anticipation of the success of his first ascent.

"The balloon is 150 feet in circumference; and the extreme height of the whole, when inflated, and with the car attached, Mr. Green stated, would be 80 feet. It is formed of 2000 yards of silk, imported raw from Italy, in part, dyed crimson by Messrs. Soper, of Spitalfields. The silk is cut in forty-four gores, alternately crimson and white; their length is 90 feet; they are joined by each overlaying the other, and being doubly stitched; and the seams are overlaid by a cement of such a tenacious nature, that, when once dry, the joint becomes the strongest part; this cement or varnish filling up the minute space left by the many thousand stitches, which might otherwise allow some escape of gas. The whole of the silk is also coated with a kind of varnish, formed of caoutchouc dissolved in turpentine, and mixed with a certain proportion of boiled oil, the manufacture of which appertains to Mr. Green's *arcana* of balloon making. The wooden covering being removed from the neck of the bag, we were invited within the vast machine, on condition of taking off our boots, to prevent injury to the silk; but were content to stoop and take a view of the interior of the vast hemispheroid. The effect was, indeed, striking; the light from the openings in the building streaming through the alternate gores of crimson and yellow, half the number having assumed that color from the varnish. The appearance of so vast a roof, unsupported save by air, and ever and anon rising and falling in graceful undulations, reminded us of the strict analogy of the atmosphere to a fluid. As festive associations are inseparable from Vauxhall, we thought a table might be spread for a 'goodly companie' beneath this fairy-like vault, redolent, as it was, of boiled oil.

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"It has been mentioned that the bag was scarcely half filled; the weight of atmospheric air sufficient to inflate it, would be about 5346 lbs.; while the silk so inflated would sustain an atmospheric pressure of 20,433,600 lbs., or 9122 tons. To inflate the bag with pure hydrogen gas, would require about 364 lbs., at a cost of about 250*l.*; the machine would have an ascending power of 4982 lbs.; and allowing 700 lbs. for the weight of the silk and apparatus, and 362 lbs. for ballast, it would ascend with twenty-eight persons of the average weight of 140 lbs. each. Now, the cost of the 70,000 feet of coal gas is but 70*l.*; this, indeed, is an extraordinary charge, being at the rate of 20*s.* for every 1000 feet, although the gas for lighting streets or shops is charged at 9*s.* for every 1000 feet. Unless the balloon gas be of purer quality than the latter kind, the company supplying it cannot be commended for their liberality towards experimental science.

"Having inspected the silken bag, we were shown the valve, of leather upon wooden frame work, and thickly coated with the varnish. Beside, lay the net for enveloping the silk—an excellent specimen, by the way, of hempen manufacture.

"We now crossed the grove, and ascended to one of the octagonal supper rooms, wherein was the car for the balloon. It is of oblong form, with elliptical ends, somewhat deep, and having a seat around it, the whole being of strong basket work; and to insure safety, the cords by which the car is attached to the silk bag, are plaited with wicker. At each end of the car, is the head of a colossal eagle, richly gilt. The draperies for the covering of the car were in readiness; they are purple and crimson velvet, richly embroidered.

ASCENT WITH THE VAUXHALL BALLOON.

"The ascent with this stupendous balloon took place at the Gardens, on Friday, the 9th inst. The day, 'big with fate,' was auspicious in the morning; but, at two o'clock, the weather changed, and from that time until half past four, it rained incessantly. The balloon having been removed to a piece of ground adjoining the fire-work walk, the inflation commenced at ten minutes past eleven, and in the space of twelve minutes the balloon possessed sufficient power to support itself. Thirty-six policemen were placed around it, each taking charge of one of the cords connected with the network. In about an hour, an iron half-hundred weight was also attached to each cord, and shortly after, five more in different parts, making in all, forty-one weights of fifty-six pounds each. These were soon three feet from the ground, and the policemen were compelled to pass their staves through several of the meshes, to prevent the cords cutting their hands. This combined resistance was, however, found insufficient; and twenty other persons were called to assist the policemen. By this time, Mr. Green calculates that the netting and silk must have absorbed 300 lbs. weight of water, besides the quantity retained on the top of the balloon, by the pressure of the net on the silk, each mesh forming a small reservoir.

"The inflation was superintended by Mr. Hutchinson, engineer to the London Gas Company, and was completed, under all favorable circumstances, in four hours and five minutes. The labor of attaching the car to the net was now commenced, and from the shrinking of the ropes by the wet, and the adjustment requisite at the first ascent, occupied some time. Twenty-four bags of ballast, weighing together 400 lbs., were then placed in the bottom of the car, and the grapple, or anchor was laid in: this is of wrought iron, and was attached to an elastic, caoutchouc cord, from the factory of Mr. Sirvier, which will, in a great measure, prevent any sudden jerk in stopping the balloon in rough weather, whereby many accidents have occurred. The balloon being now ready, the party took their seats in the car; there were nine persons: Mr. Green, Mrs. Green, Miss Mary Anne Green, niece of Mr. Green, Mr. James Green, his brother, Captain Currie, Mr. Hildyard, Mr. Holland, and Mr. Edwin Gye, and Mr. William Hughes, sons of the proprietors of Vauxhall Gardens.

"The appearance of the balloon was truly magnificent; and though ponderous, nothing could exceed its graceful beauty; as shown in the previous engraving, from a lithograph, by Mr. Cocks, the artist to the Gardens. It should, however, be remarked that the network has been added.

"Mr. Green had calculated the ascending power of the balloon from the average specific gravity of the gas made by the different companies, and found it to be considerably more than he announced to the public; for, it was found that, instead of carrying up from eight to ten persons, the number stated, there was buoyancy enough to take up twenty persons. Mr. Green was, therefore, compelled to allow about 15,000 feet of gas (more than one-fifth of the whole power) to escape, before he could release the balloon from its moorings; the ascending power being much too great, and there not being room in the car for more voyagers. To this circumstance is to be ascribed the apparent smallness of the balloon to the distant spectators, and the absence of that regularity of form which is at all times to be remarked in an inflated body. All being now ready, the signal-gun was fired, the ropes were cut, and the balloon shot rapidly into the nether regions. Mr. Green's narrative of the voyage is subjoined.

NARRATIVE.

"We proceeded at first to the east, but soon took a south-easterly direction, leaving Greenwich and Woolwich to the left. The gardens, and every avenue leading to them, appeared to be one solid mass of human beings; in fact, there was not an elevated spot within two miles of the metropolis, which was not crowded with spectators. We had ascended about three-quarters of a mile when we found ourselves in a brilliant sunshine, which formed a strong contrast to the dense and clouded atmosphere we had just left. The gas now expanded rapidly, and the silk, down to the bottom of the neck, was completely distended. We, of course, ascended with great velocity, and in less than five minutes, the fall of the mercury in the barometer indicated a height of two miles and a quarter; this was our greatest elevation, and it being nearly dark, I thought it unadvisable to ascend higher; therefore, suffering a small portion of gas to escape from the valve, we commenced our descent. We were now nearly opposite Gravesend, and had crossed the Thames several times. The grappling iron first touched the ground near the village of Cliffe, in Kent; and, after slightly catching several times, took a firm hold. A slight breeze springing up at this moment, the jerk caused the hoop, to which the grapple rope was fastened, to give way, which rendered it necessary to open the valve very wide. This done, the car soon touched the ground. We then drifted about a hundred yards, and the valve being kept open, the stupendous machine, which so lately exhibited its giant power, lay motionless on the ground.

"All my companions expressed the greatest delight during the voyage, and enjoyed themselves much; indeed, so loud was their mirth several times, that I had some difficulty in making my directions audible; for, I assigned a duty to each, such as watching the rise or fall of the mercury in the barometer and thermometer, throwing out ballast, &c. Being forced to take such a large quantity of ballast, we found the car too small; but a new one, much larger, will be constructed for the next ascent. We slept at the village of Cliffe, proceeding to Gravesend yesterday (Saturday) morning, and arrived in town at ten o'clock at night. C. GREEN."

"Among the advantages to be gained from the vast increase in the balloon, Mr. Green states the following: 'A much greater elevation will be attained than has hitherto been, and the long agitated question decided as to whether there are, at a great altitude, currents of air in one direction for several months together. This, Mr. Green from many observations he has made, believes to be the case at an altitude where the atmosphere is not acted upon by the reflection of the sun's rays from the earth, or dense masses of clouds. Should this theory be correct, a grand step in the progress of aeronautics will be made. Before the next ascent of this balloon, a larger car will, doubtless, be provided; and Mr. Green proposes a small chamber to be attached in place of the car, in which from three to six persons can ascend, with ample space and convenience for experimental apparatus.'

"It should be added, that the records of aeronautics present few instances of such success as has rewarded Mr. Green and the proprietors of Vauxhall Gardens, in the construction of this vast balloon. The enterprise has, in every particular, been so well managed, that too much credit can scarcely be given to the skill, experience, and liberality of the respective parties. More than was promised to the public has been performed; so that their patronage has, in every instance, been well bestowed upon this costly experiment. The expense of constructing the balloon is calculated at 2100*l.*: the expense of the silk, which is of excellent quality, was 700*l.*"

CHAPTER XVIII.

Great aeronautical expedition from London to Weilburg, across the sea—Made by Robert Hollond Esq., Monck Mason, Esq., and Charles Green, aeronaut—Written by Monck Mason.

"*To Robert Hollond, Esq., to whose liberal and enterprising spirit the late expedition owes its origin and success, the following sketch is inscribed, as a slight testimony of the regard and respect in which he is held by his sincere friend and faithful servant,*
M. MASON.

"Paris, Dec. 1836.

ACCOUNT OF THE AERONAUTICAL EXPEDITION FROM LONDON TO WEILBURG.

"THE interest with which the public at all times appear to have regarded the progress of aerostation, and especially the very flattering concern which they have deigned so unequivocally to express for the successful issue of our late undertaking, have concurred in inducing me to abandon the usual path of communication hitherto adopted upon such occasions, and confirm me in the opinion that some account, more accurate and detailed than is generally to be found in the columns of the public press, might not prove unacceptable to those for whose sympathy and consideration we can never acknowledge ourselves sufficiently grateful. In this belief, which I hope may not be deemed fallacious, I have seized the first vacant moment since our descent, to embody in the present form all those incidents and observations to which a voyage so singular is so amply calculated to give rise. It is true that many of these have already reached the public ear through the medium of the public press, while at the same time, no doubt, much of the interest which owes its origin to the uncertainty and supposed peril of such exploits must have already subsided in the knowledge of the result, and of the leading features, which our duty to the public made it imperative upon us immediately to divulge. It is not, however, in the mere issue, successful or unsuccessful, that the chief merit or importance of such an enterprise can alone be said to consist. Designed with a view to special ends, and undertaken for the sole purpose of ascertaining and establishing the efficacy of certain improvements in the art, from which most beneficial results *were*, and I am now happy to add *are*, most likely to accrue, it becomes no less an obligation to ourselves than to the world in general, to make them partakers in the knowledge of whatever interesting or important circumstances either accompanied the progress of our expedition, or may justly be expected to attend the adoption of those improvements, the merits of which it was our sole object in the present instance to confirm.

"From the time of the first discovery of the properties and power of the balloon,* up to a late period (already a lapse of more than half a century), a variety of obstacles apparently insurmountable continued to obstruct the progress, and paralyze the efforts of all who sought to render it obedient to the sway of human will, and subservient to the purposes of human life. The chief of these impediments consisted in the uncertainty and expense attending the process of inflation from the employment of hydrogen gas; the dangers considered inseparable from the practice of the art; the difficulties which hitherto have baffled all attempts to give a direction to the ungovernable mass, and the impossibility which all previous aeronauts have experienced of remaining in the air a sufficient time to ensure the attainment of a sufficient distance.

"To remove these obstacles and reduce the aerial vehicle to a more certain issue, a vast extent of actual experience, united to an intellect capable of turning it to a proper account, was absolutely required; and it would be an act of much injustice were I not to declare, that it is to the combination of both these in the person of Mr. Charles Green, that we are indebted for the entire results of all that is beneficial in the practice, or novel in the theory of this, the most delightful and sublime of all sublunary enjoyments.

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* It may not be uninteresting to those concerned in the annals of aerostation, to mention that the widow of the celebrated Montgolfier, the first inventor of the balloon, to which his name continues to be attached, is at this present moment living in Paris; and, though in her eighty-second year, in the perfect enjoyment of all her faculties, ardent in the advancement of the art, and hospitable in the reception of those who cultivate it. I had the pleasure of dining at her table, since our arrival, and of hearing from her own lips many of those curious anecdotes illustrative of its origin and progress, which, indeed, appear at all times to have accompanied the first dawning of great and important discoveries.

"It was to him, and to his discovery of the applicability of coal gas to the purposes of inflation, that we owe the removal of the first of those impediments in practice, which till then had continued to weigh down with a leaden hand the efforts of the most indefatigable and expert, and had, in fact, bid fair to quench the incipient science in its very onset.

"Up to the period of that discovery, the process of inflation was one, the expense of which was only to be equaled by its uncertainty: two, and sometimes even three days of watchful anxiety have been expended in the vain endeavors to procure a sufficiency of hydrogen to fill a balloon, from which, on account of its peculiar affinities, it continued to escape almost as fast as it was generated; during all which time the various casualties of wind and weather, the inevitable imperfections of a vast and cumbrous apparatus, and above all the enormous expense attending this operation, were to be incurred and endured, for the sole purpose, and with the sole object of remaining for a few hours helplessly suspended in the air. Under such disadvantages, all prospect of advancement in the art had speedily disappeared; and it was only by the timely intervention of Mr. Green's ingenious application that the art itself was saved from a premature extinction—aerostation had gone to sleep, when, roused by this discovery, she awoke to redoubled efforts, and rendered that, in the hands of the *skillful*, a profession and a profit, which before had ever been a matter of doubt, difficulty, and distress.*

"With respect to the next of those impediments, which in the opinion of mankind might have continued to oppose the adoption of aerostation as an organ of general utility—I mean the danger usually considered as consequent upon the exercise of the art, much is not required to prove the fallacy of such fears; two hundred and twenty-six ascents,† undertaken at all periods of the year, without one disappointment to the public, and without one solitary instance of fatal consequences, or even of an accident of disagreeable results (except from the intervention of malice),* ought to be a sufficient proof of how little danger is to be apprehended in the practice of aerostation, when, under the management of a skillful leader, and with the aid of those improvements to which his experience has given rise. It is not from the bungling efforts of unqualified persons that any judgment should be formed on this or other matters of practical detail; and where that skill is present, without which no one has a right to expect success, and those precautions have been observed which experience has shown to be requisite, I do not hesitate to say, that the practice of aerostation is as devoid of extraordinary danger as that of any other mode of conveyance hitherto adopted.†

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* Independent of the diminution of expense and risk, from the employment of coal gas, in preference to hydrogen, for the purpose of inflation, there are other advantages of great importance, one of which merits special notice. I allude to the superior facility with which the latter is retained in the balloon, owing to the greater subtility of the particles of hydrogen, and the strong affinity which they exhibit for those of the surrounding atmosphere. In a balloon, sufficiently perfect to retain its contents of coal gas unaltered in quality or amount for the space of six months, an equal quantity of hydrogen could not be maintained in equal purity for an equal number of weeks.

† The amount of Mr. Green's public ascents, up to the present period.

"Great, however, as are the merits of Mr. Green's previous discoveries, they may be said to yield in importance to that whereby he has succeeded in enabling the aeronaut to maintain the power of his balloon undiminished during the continuance of the most protracted voyage it could ever be required to perform. In order fully to comprehend the value of this discovery, which more immediately formed the object of our late enterprise, it is necessary that some idea should be had of the difficulties it was intended to obviate, and of the effects they were calculated to produce upon the further progress of aerostation. When a balloon ascends to navigate the atmosphere, independent of the loss of power occasioned by its own imperfections, an incessant waste of its resources in gas and ballast becomes the inevitable consequence of its situation. No sooner has it quitted the earth than it is immediately subjected to the influence of a variety of circumstances tending to create a difference in its weight; augmenting or diminishing, as the case may be, the power by the means of which it is supported. The deposition or evaporation of humidity to the extent, in proportion to its size, of several hundred weight; the alternate heating and cooling of its gaseous contents by the remotion or interposition of clouds between the object itself and the influence of the solar rays, with a variety of other more secret, though not less powerful agencies, all so combine to destroy the equilibrium which it is the main object of the aeronaut to preserve, that scarcely a moment passes without some call for his interposition, either to check the descent of the balloon by the rejection of ballast, or to control its ascent by the proportionate discharge of gas; a process by which, it is unnecessary to observe, the whole power of the balloon, however great its dimensions, must in time be exhausted, and sooner or later terminate its career by succumbing to the laws of terrestrial gravitation. By the simple contrivance of a rope of the requisite magnitude and extent, trailing on the ground beneath (and if over the sea, with a sufficient quantity of liquid ballast contained in vessels floating on its surface), have all these difficulties been overcome, and all the features of the art completely and effectually reversed. Harnessed to the earth or ocean, by a power too great for her to resist, it is in vain the balloon endeavors to change the level of her onward course; every foot she would have been otherwise compelled to add to her elevation now only adds to her weight, by her endeavors to abstract from the earth a further portion of that rope which is dependent upon its surface; while, on the other hand, every foot she would have been inclined to descend, had she been at liberty as heretofore, now only abstracts from the weight which draws her downward, by throwing on the earth the labor of supporting an additional portion of the guide-rope, which she would otherwise have had to sustain without relief. Limited to one unalterable plane, all the fluctuations above mentioned, whereby her irreparable stock of power became subjected to incessant waste, have thus completely been avoided, and not only her ascensive force maintained in its full vigor throughout a period determinable solely by her own imperfections, but at all times, and under all circumstances, over the boundless ocean without a landmark in the densest fog, and throughout the darkest night the exact direction of her course, as well as the very rate of her progress, determined with the utmost facility and most infallible results.* The main feature, however, in this discovery, is the altered aspect under which it enables the aeronaut to regard the perils of the sea, and the consequent extension it bestows upon the hitherto limited sphere of his relations. The ocean, now no longer the dreaded enemy of the aerial voyager, becomes at once his greatest friend; and instead of opposing his progress, offers him advantages more certain and efficacious than even the earth itself with all its presumed security, is calculated to contribute.

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* In an ascent from Cheltenham, a few years ago, in which Mr. Green was accompanied by Mr. Griffiths, some malicious scoundrel contrived to sever the ropes of the car in such a manner as not to be perceived before the balloon had reached a considerable elevation, whereby the parties were precipitated to the ground, and very narrowly escaped destruction. Neither the author of this premeditated villainy, nor the design it was intended to answer, has ever yet been discovered, although a reward of one hundred guineas was immediately offered for his detection.

† It will be observed, that no reference is here made to the state of the art in respect of the power of guiding the balloon according to a given direction; the want of which, is generally considered as the most effectual obstacle to its further progress and adaptation to the ordinary purposes of human life. As the discussion, however, of this question would tend to a considerable digression, and as it likewise formed no part of the project in pursuance of which our late expedition was undertaken, I have thought it preferable to omit all mention of it for the present, reserving for a future opportunity a more elaborate investigation of the case, than would be here either consistent or agreeable.

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* The progress of the guide-rope being delayed to a certain extent by its motion over the more solid plane of the earth's surface, while the movement of the balloon is as freely as ever controlled by the propelling action of the wind, it is evident that the direction of the latter when in progress, must ever be in advance of the former; a comparison therefore of the relative positions of these two objects by means of the compass, must at all

"Such then was the actual state of aerostation when Mr. Robert Hollond, a gentleman who had long cultivated a practical acquaintance with the art, resolved to afford an opportunity for a full display, and unequivocal determination of the merits of these discoveries, by undertaking at his own expense to fit out an expedition, under the guidance of Mr. Green (in which he was so kind as to include me), for the purpose and with the intention of starting from London, and proceeding (in whatever direction the winds at that time prevailing might happen to convey us), to such a distance as would suffice to answer the ends for which the voyage was especially designed. Accordingly, the proprietors, Messrs. Gye and Hughes, having kindly conceded the use of the great Vauxhall balloon and of their premises, for the purpose of the ascent; after several unavoidable delays, occasioned chiefly by the weather, the day of departure was fixed for Monday, November 7th, 1836, and the process of inflation having been commenced at an early hour, everything was got ready for starting by one o'clock in the afternoon of the same day.

"The appearance which the balloon exhibited previous to the ascent, was no less interesting than strange. Provisions, which had been calculated for a fortnight's consumption in case of emergency; ballast to the amount of upwards of a ton in weight, disposed in bags of different sizes, duly registered and marked, together with an unusual supply of cordage, implements, and other accessories to an aerial excursion, occupied the bottom of the car; while all around the hoop, and elsewhere appended, hung cloaks, carpet-bags, barrels of wood and copper, coffee-warmer,* barome-

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times indicate the exact direction of her course; while with equal certainty, an estimate can at once be obtained of the velocity with which she is proceeding, by observing the angle formed by the guide-rope and the vertical axis of the machine. In proportion as this angle enlarges, an increase in the rate of the balloon may be infallibly inferred; and, vice versâ, its diminution will be found to correspond exactly with the diminished velocity of her advance. When the rope is dependent perpendicularly, no angle of course is formed, and the machine may be considered as perfectly stationary, or at least endowed with a rate of motion too insignificant to be either appreciable or important.

* A machine had been contrived for the purpose of warming coffee and other liquors, without the intervention of fire, by the means of slaked

ters, telescopes, lamps, wine jars and spirit flasks, with many other articles, designed to serve the purposes of a voyage to regions, where once forgotten, nothing could be again supplied.

"Among the other matters with which we had taken the precaution to provide ourselves, were passports directed to all parts of the continent, specifying the peculiar nature of our voyage, and entitling us to exemption from the usual formalities of office.

"In addition to these, we were also charged with a letter to His Majesty the King of Holland, from Mr. May, His Majesty's Consul-General in London; which was put into the post-office at Coblentz, on the evening of the day succeeding our departure.*

"Thus prepared, and duly accoutred, at half-past one o'clock the balloon was dismissed from the ground, and rising gently under the influence of a moderate breeze, bore speedily away towards the south-east, traversing in her course the cultivated plains of Kent, and passing in succession nearly over the towns of Eltham, Bromley, Footscray, and others, whose variegated outlines beautifully diversified the rich landscape that lay beneath us. The weather was uncommonly fine for the time of year; a few light clouds alone floated in the sky, and at least as useful as ornamental, served to indicate the existence of different currents at different altitudes; an information of which, it will

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lime, which answered the purpose sufficiently well, although the danger which it was intended by these precautions to avoid, is really not such as to require the aid of such appliances; with that degree of prudence and attention which can at all times be commanded, no real peril is to be apprehended from the use of actual fire. During the whole night, we had a lamp constantly burning, nor did we at any time suffer anxiety on account of its presence, or perceive any occasion, even temporarily, to wish for its extinction.

* Of the due arrival of this letter, and his Majesty's gracious reception of it, we received the following testimony in a letter from Mr. May, shortly after we reached Paris.

London, November 28, 1836.

Sir—Perceiving from the accounts in the newspapers that you and your friends have arrived at Paris, I lose no time in having the satisfaction of thanking you very sincerely, for the care taken of the letter I took the liberty of entrusting to your kindness, for the purpose of having it forwarded to the king, at the Hague; it reached its destination on the 12th of November, through the post-office at Coblentz, and his majesty was very much gratified at receiving a letter from England, by so novel a mode of conveyance as a balloon. The king has written a memorandum on the letter "*to be carefully preserved;*" wishing to keep it as a remembrance of this, as yet, extraordinary occurrence. I congratulate you and your companions on the success of your enterprise, and remain with great regard, sir,

Your most obedient, humble servant,
J. W. MAY.

be seen hereafter, we were enabled to avail ourselves with much effect.

"Continuing in a south-easterly direction, at forty-eight minutes past two* we crossed the Medway, at the distance of about six miles to the west of Rochester, and in little more than an hour after† were in sight of the city of Canterbury, the lofty towers of its cathedral bearing distant about two miles in a westerly direction. In honor of the mayor and inhabitants of that city, under whose patronage our celebrated pilot had twice before ascended, we lowered a small parachute containing a letter addressed to the mayor, and couched in such terms as our hurried passage would permit us to indite.‡

"In a few minutes after,§ we obtained our first view of the sea, brightening under the last rays of a setting sun, and occupying the extreme verge of the horizon, in the direction in which we were now rapidly advancing.

During the latter period of this part of our voyage, the balloon, perhaps owing to the condensation occasioned by the approaching shades of evening, had been gradually diminishing her altitude, and for some time past had continued so near the earth as to enable us, without much exertion, to carry on a conversation with such of the inhabitants as happened to be in our immediate vicinity. So close, indeed, were we, at one time, as to be able distinctly to observe a covey of partridges, which either our approach, or some other equally dreaded apparition, had dislodged from their resting place, and sent to seek a refuge on the borders of a wood which lay adjacent. A whole colony of rooks, alarmed no doubt by our formidable appearance, rose, likewise, in dismay, and, after rending the air for miles round with their cries, and vainly trying the protection of the neighboring woods, finally dispersed, scattering themselves in every direction over the surface of the earth beneath.

"It was at this period of our voyage that the first opportunity occurred of showing how far it was possible for the skillful and experienced aeronaut to influence the course of his aerial vessel, by availing himself of the advantages which circumstances frequently place at his disposal. Shortly after we had lost sight of the city of Canterbury, a considerable deviation appeared to have taken place in the direction of our route. Instead of pursuing our former line of south by east, which was that of the upper current, by means of which we had hitherto advanced, it became apparent that we were now rapidly bearing away upon one which tended considerably to the northward, and which, had we continued to remain within the limits of its influence, would have shortly brought us to sea, in the direction of the North Foreland. As it had all along been an object to proceed as near to Paris as circumstances would permit,* we resolved to recover as soon as possible the advantages which a superior current had hitherto afforded us; and accordingly rose to resume a station upon our previous level. Nothing could exceed the beauty of this manœuvre, or the success with which the balloon acknowledged the influence of her former associate. Scarcely had the superfluous burden been discharged proportioned to the effect required, when slowly she arose, and sweeping majestically round the horizon, obedient to the double impulse of her increasing elevation and the gradual change of current, brought us successively in sight of all those objects which we had shortly before left retiring behind us, and in a few minutes placed us almost vertically over the castle of Dover, in the exact direction of crossing the Straits between that town and Calais, where it is confined within its narrowest limits.†

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* The times and distances, as well as the direction of our course by the compass, during the voyage, being taken from the notes kept by Mr. Hollond on the occasion, will account for the exact correspondence on these points, between the different relations already before the public, which, without this explanation, might perhaps appear to border a little on the extraordinary.

† Five minutes past four.

‡ Of the due receipt of this letter, as well as of one to the same effect, which we subsequently addressed to the mayor of Dover, we have since been informed; though the others which we discharged by similar means, at different periods of our voyage, we have reason to believe, never reached the hands for which they were designed.

§ Fifteen minutes past four.

"It was forty-eight minutes past four when the first line of waves breaking on the beach appeared beneath us, and we might be said to have fairly quitted the shores of our native soil, and entered upon the hitherto dreaded regions of the sea.

"It would be impossible not to have been struck with the grandeur of the prospect at this particular moment of our voyage;

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* The proprietors of the balloon having contemplated making an ascent from Paris, and Mr. Hollond having undertaken to transfer the balloon thither, it became a consideration with us, not to increase our distance from that capital, more than was consistent with the main object of the expedition.

† It was undoubtedly at this period of our voyage, while the rapidity of our course appeared to be delayed by the circuitousness of our route, the length of time we consequently remained in sight, and above all, the rectilinear direction of our approach, that originated the observation contained in the newspapers, that the progress of the balloon did not exceed the rate of four or five miles an hour; an assertion which a slight consideration of the time we had left London, and the distance we had accomplished, would have been sufficient to disprove. According to the above method of calculation, the mean rate of our course, up to the time referred to, was somewhat more than twenty-five miles an hour.

the more especially as the approaching shades of night rendered it a matter of certainty that it would be the last, in which earth would form a prominent feature, that we might expect to enjoy for a considerable lapse of time. Behind us, the whole line of English coast, its white cliffs melting into obscurity, appeared sparkling with the scattered lights, which every moment augmented, among which the light-house at Dover formed a conspicuous feature, and for a long time served as a beacon whereby to calculate the direction of our course. On either side below us the interminable ocean spread its complicated tissue of waves without interruption or curtailment, except what arose from the impending darkness, and the limited extent of our own perceptions; on the opposite side a dense barrier of clouds rising from the ocean like a solid wall, fantastically surmounted, throughout its whole length, with a gigantic representation of parapets and turrets, batteries and bastions, and other features of mural fortifications, appeared as if designed to bar our further progress, and completely obstructed all view of the shores, towards which we were now rapidly drawing. In a few minutes after, we had entered within its dusky limits, and for a while became involved in the double obscurity of the surrounding vapors, and of the gradual approach of night. Not a sound now reached our ears; the beating of the waves upon the British shores had already died away in silence, and from the ordinary effects of terrestrial agitation our present position had effectually excluded us.*

"In this situation, we prepared to avail ourselves of those contrivances, the merits of which, as I have already stated, it was one of the main objects of our expedition to ascertain; and consequently to provide against the loss of power by the increase of weight proceeding from the humidity of the atmosphere, naturally to be expected on the approach of night, we commenced lowering the copper vessels which we had provided for the occasion.

"Scarcely, however, had we completed our design, and were patiently awaiting the descent we had anticipated, when the faint sound of the waves beating against the shore again returned upon our ears, and awakened our attention. The first impression which this event was calculated to convey, was that the wind had changed, and that we were in the act of returning to the shores we had so shortly before abandoned. A glance or two, however, served to show us the fallacy of this impression; the well-known lights of Calais and of the neighboring shores were already glittering beneath us; the barrier of clouds which I have before mentioned as starting up so abruptly in our path, as abruptly terminated; and the whole adjacent coast of France, variegated with lights, and ripe with all the nocturnal signs of population, burst at once upon our view. We had, in fact, crossed the sea; and in the short space of about one hour, from the time we had quitted the shores of England, were floating tranquilly, though rapidly, above those of our Gallic neighbors.

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* I scarcely know whether it is an observation worthy of being committed to paper, that the sea, unless *perhaps* under circumstances of the most extraordinary agitation, does not in itself appear to be the parent of the slightest sound; unopposed by any material obstacle, an awful stillness seems to reign over its motions. Nor do I think that even under *any* circumstances, no matter how violent, can any considerable disturbance arise from the conflict of its own opposing members. The impossibility of ever having been placed in a situation to bring this fact under the cognizance of our senses, is no doubt the reason why it has never before been noticed. On the shore or in the sea, no one has ever been present, independent of that material support, the absence of which is necessary to the success of the experiment; it is in the balloon alone, suspended in elastic ether, that such a phenomenon could either have been verified or observed.

"It was exactly fifty minutes past five when we had thoroughly completed this *trajet;* the point at which we first crossed the French shore bearing distant about two miles to the westward of the main body of the lights of Calais, our altitude at the time being somewhat about three thousand feet above the level of the ocean. As it was now perfectly dark, we lowered a Bengal light, at the end of a long cord, in order to signify our presence to the inhabitants below; shortly after, we had the satisfaction to hear the beating of drums, but whether on our account, or merely in performance of the usual routine of military duty, we were not at the time exactly able to determine.

"Before dismissing the sea, a word or two seems required to counteract a vague and incorrect impression regarding its peculiar influence upon the buoyancy of the balloon, arising from the difficulties experienced by Messrs. Blanchard and Jeffries in their passage of the same straits in the year 1785, and the apparently unaccountable remotion of their difficulties as soon as they had reached the opposite coast. So many, however, are the circumstances within the range of aeronautical experience to which, without intruding upon the marvellous, or calling new affinities into existence, these effects can be satisfactorily attributed, that the actual difficulty lies in ascertaining to which of them they are most likely to have owed their origin: of these the increase of weight by the deposition of humidity on the surface of the balloon, occasioned by the colder atmosphere through which the first part of their journey had to be pursued, and the subsequent evaporation of the same by the rise of temperature to which they necessarily became subjected as soon as they came within the calorific influence of the land, is in itself quite sufficient to explain the difference that existed in the buoyancy of the balloon, during the different stages of its progress. Even in the absence of any humidity whereby the actual weight of the balloon could have been increased, the mere diminution of temperature, by condensing its gaseous contents; and their subsequent rarefaction by the altered temperature they were sure to encounter when they reached the opposite coast, are more than enough to account for much greater effects than even those to which it is here intended to apply. As far as we were concerned, certainly no such uncommon impression was observable, nor did we experience any diminution of ascensive power in our transit across the sea, beyond what we should have expected under similar circumstances over a similar extent of land.

"The night having now completely closed in, and no prospect of any assistance from the moon to facilitate our researches, it was only by means of the lights which either singly or in masses, appeared spreading in every direction, that we could hope to take any account of the nature of the country we were traversing, or form any opinion of the towns or villages which were continually becoming subjected to our view.

"The scene itself was one which exceeds description. The whole plane of the earth's surface, for many and many a league around, as far and farther than the eye distinctly could embrace, seemed absolutely teeming with the scattered fires of a watchful population, and exhibited a starry spectacle below that almost rivaled in brilliancy the remoter lustre of the concave firmament above. Incessantly, during the earlier portion of the night, ere the vigilant inhabitants had finally retired to rest, large sources of light, betokening the presence of some more extensive community, would appear just looming above the distant horizon in the direction in which we were advancing, bearing at first no faint resemblance to the effect produced by some vast conflagration, when seen from such a distance as to preclude the minute investigation of its details. By degrees, as we drew nigh, this confused mass of illumination would appear to increase in intensity, extending itself over a larger portion of the earth, and assuming a distincter form and a more imposing appearance, until at length, having attained a position from whence we could more immediately direct our view, it would gradually resolve itself into its parts, and shooting out into streets, or spreading into squares, present us with the most perfect model of a town, diminished only in size, according to the elevation from which we happened at the time to observe it.

"It would be very difficult, if not impossible, to convey to the minds of the uninitiated any adequate idea of the stupendous effect which such an exhibition, under all its concomitant peculiarities, was calculated to create. That we were, by such a mode of conveyance, amid the vast solitude of the skies, in the dead of night, unknown and unnoticed, secretly and silently reviewing kingdoms, exploring territories, and surveying cities, in such rapid succession as scarcely to afford time for criticism or conjecture, was in itself a consideration sufficient to give sublimity to far less interesting scenes than those which formed the subject of our present contemplations. If to this be added the uncertainty that from henceforward began to pervade the whole of our course—an uncertainty that every moment increased as we proceeded deeper into the shades of night, and became further removed from those landmarks to which we might have referred in aid of our conjectures, clothing everything with the dark mantle of mystery, and leaving us in doubt more perplexing even than ignorance as to where we were, whither we were proceeding, and what were the objects that so much attracted our attention—some faint idea may be formed of the peculiarity of our situation and of the impressions to which it naturally gave rise.

"In this manner, and under the influence of these sentiments, did we traverse with rapid strides a large and interesting portion of the European Continent; embracing within our horizon an immense succession of towns and villages, whereof those which occurred during the earlier part of the night, the presence of their artificial illumination alone enabled us to distinguish.

"Among these latter, one in particular, both from its own superior attractions, the length of time it continued within our view, and the uninterrupted prospect which our position directly above it, enabled us to command, captivated our attention and elicited constant expressions of mingled admiration and surprise. Situated in the centre of a district which actually appeared to blaze with the innumerable fires wherewith it was studded in every direction to the full extent of all our visible horizon, it seemed to offer in itself, and at one glance, an epitome of all those charms which we had been previously observing in detail. The perfect correctness with which every line of street was marked out by its particular line of fires; the forms and positions of the more important features of the city, the theatres and squares, the markets and public buildings, indicated by the presence of the larger and more irregular accumulation of lights, added to the faint murmur of a busy population still actively engaged in the pursuits of pleasure or the avocations of gain, all together combined to form a picture which for singularity and effect certainly could never have been before conceived. This was the city of Liege, remarkable from the extensive iron works which, abounding in its neighborhood, occasioned the peculiar appearance already described, and at the time led to that conjecture concerning its identity, the truth of which a subsequent inquiry enabled us to confirm.

"This was the last spectacle of the kind which we were destined to enjoy. Scarcely had we completely cleared the town and the fiery region in which it was embosomed, ere an unbroken obscurity, more profound than any we had yet experienced, involved us in its folds, and effectually excluded every terrestrial object from our view.

"It was now past midnight, and the world and its inhabitants had finally committed themselves to repose. Every light was extinguished, and every sound hushed into silence; even the cheerful tones of the vigilant watch-dog, which had frequently contributed to enliven our course during the previous portion of the night, had now ceased; and darkness and tranquillity reigned paramount over the whole adjacent surface of the globe.

"From this period of our voyage until the dawning of the following day, the record of our adventures becomes tinged with the obscurity of night. The face of nature completely excluded from our view, except when circumstances occasionally brought us into nearer contact with the earth, all our observations during the above period are necessarily confined to a register of incidents and sensations mingled with vague conjectures, and clouded with the mystery wherewith darkness and uncertainty were destined to involve so large a portion of the remainder of our expedition. The moon, to which we might have looked up for companionship and assistance, had she been present, was nowhere to be seen. The sky, at all times darker when viewed from an elevation than it appears to those inhabiting the lower regions of the earth, seemed almost black with the intensity of night; while, by contrast, no doubt, and the remotion of intervening vapors, the stars, redoubled in their lustre, shone like sparks of the whitest silver scattered upon the jetty dome around us. Occasionally faint flashes of lightning, proceeding chiefly from the northern hemisphere, would for an instant illuminate the horizon, and after disclosing a transient prospect of the adjacent country, suddenly subside, leaving us involved in more than our original obscurity. Nothing in fact could exceed the density of night which prevailed during this particular period of the voyage. Not a single object of terrestrial nature could anywhere be distinguished; an unfathomable abyss of 'darkness visible' seemed to encompass us on every side; and as we looked forward into its black obscurity in the direction in which we were proceeding, we could scarcely avoid the impression that we were cleaving our way through an interminable mass of black marble in which we were imbedded, and which, solid a few inches before us, seemed to soften as we approached, in order to admit us still farther within the precincts of its cold and dusky enclosure. Even the lights which at times we lowered from the car, instead of dispelling, only tended to augment the intensity of the surrounding darkness, and as they descended deeper into its frozen bosom, appeared absolutely to melt their way onward by means of the heat which they generated in their course.

"The cold, during this part of the night especially, was certainly intense, as could be perceived not less from the indications of the thermometer (ranging variously from within a few degrees below, to the point of congelation), than from the effects which it produced upon the different liquors wherewith we were provided. The water, coffee, and, of course, the oil in our several vessels were completely frozen; and it was only by the actual application of the heat of the lamp that we were enabled to procure a sufficiency of the latter to supply our wants, during the long term of darkness to which we were about to be subjected.

"Strange, however, as it may appear, while all around bore such unequivocal testimony to the severity of the cold, the effects produced upon our persons, undefended as they were by any extraordinary precautions, were by no means commensurate to the cause, nor such as even, under ordinary circumstances, we might fairly have expected to encounter. The reason to which may be attributed this unusual exemption from the consequences of a low temperature, is the absence of all current of air, the natural result of our situation, and one of the peculiar characteristics of aerial navigation.*

"To this intensity of cold, preceded by a long subjection to the action of a humid atmosphere, while floating at a lower elevation, is likewise to be attributed the occurrence of an incident, which, for the impression it is calculated to produce upon the minds of those who experience it for the first time, and in ignorance of its cause, merits particularly to be noticed.

"It was about half-past three in the morning, when the balloon, having gained a sudden accession of power, owing to a discharge of ballast, which had taken place a few minutes before, while navigating too near the earth to be considered perfectly safe in a country, with the main features of which we were totally unacquainted, began to rise with considerable rapidity, and ere we had taken the customary means to check her ascent, had already attained an elevation of upwards of twelve thousand feet. At this moment, while all around is impenetrable darkness, and stillness most profound, an unusual explosion issues from the machine above, followed instantaneously by a violent rustling of the silk, and all the signs which may be supposed to accompany the bursting of the balloon, in a region where nothing but itself exists to give occasion to such awful and unnatural disturbance. In the same instant, the car, as if suddenly detached from its hold, becomes subjected to a violent concussion, and appears at once to be in the act of sinking, with all its contents, into the dark abyss below. A second and a third explosion follow in quick succession, accompanied by a recurrence of the same astounding effects; leaving not a doubt upon the mind of the unconscious voyager of the fate which nothing now appears capable of averting. In a moment after, all is tranquil and secure; the balloon has recovered her usual form and stillness, and nothing appears to designate the unnatural agitation to which she has been so lately and unaccountably subjected. The occurrence of this phenomenon, however strange it may appear, is, nevertheless, susceptible of the simplest resolution, and consists in the tendency to enlargement from remotion of pressure which the balloon experiences in rising from a low to a higher position in the atmosphere, and the resistance to this enlargement occasioned by the net-work previously saturated with moisture, and subsequently congealed into the elliptical form which the dependent weight of the car obliges it to assume, whenever the shrunken capacity of the sphere it encompasses will admit of its longitudinal distension. As this resistance is occasioned by the intervention of a *non-elastic* medium (the ice) which has bound the meshes of the net-work in their contracted form, it is evident that the liberation occasioned by their disrupture will not take place until the internal pressure of the balloon has reached a certain amount; when *suddenly* that liberation is accomplished, attended by those collateral effects which we have already attempted to describe. The impression of the descent of the car in the above representation is evidently a false one; the car, so far from sinking, actually springs up; it is the unexpectedness of such a movement, and its apparent inconsistency with the laws of gravitation, that occasions the delusion, the reality of which the concomitant circumstances essentially tend to confirm.

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* After what has been stated respecting the temperature to which we were subjected, it will be unnecessary to offer any further disproval of the absurd reports which were circulated concerning its severity, and the serious consequences which we were supposed to have suffered from our exposure to it during the night.

"Several times, during the latter part of the night, we had approached so near to the earth, as to be enabled to observe, imperfectly, it is true, some of its most prominent features, and to obtain some faint idea of the nature of the ground beneath us. At these times, we appeared to be traversing large tracts of country partially covered with snow, diversified with forests, and intersected occasionally with rivers, of which the Meuse, in the earlier part of the night, and the Rhine, towards the conclusion, formed, as we afterwards learned, the principal objects, both of our admiration and of our conjectures.

"Large masses of fleecy clouds would, at times, likewise occupy the lower regions of the atmosphere, intercepting our view as we descended, and for a while leaving us in doubt whether they were not a continuation of those snowy districts which we so frequently had occasion to remark.

"From out of this mass of vapors, more than once during the night our ears became assailed with sounds bearing so strong a resemblance to the rushing of waters in enormous volumes, or the beating of the waves upon some extensive line of coast, that it required all our powers of reasoning, aided by the certain knowledge we had of the direction we were pursuing, to remove the conviction that we were approaching the precincts of the sea, and, transported by the winds, were either thrown back upon the shores of the German Ocean, or about to enter upon the remoter limits of the Baltic.

"It would be endless to enumerate all the conjectures to which this phenomenon gave rise, or the various manners by which we endeavored to explain its occurrence. Among them those which seemed to obtain the greatest credit, were that the sound proceeded from some vast forest, agitated by the winds; some rapid river rushing impetuously over a broken and precipitous channel; or, finally, that the misty vapors themselves, by the mutual action of their watery particles, or their precipitated deposition upon the irregular surface of the earth beneath, had occasioned the murmurs which, multiplied throughout so large a space, came to our ears, in the formidable accents to which we have above alluded. According as the day drew nigh, these appearances vanished, with much of the doubts to which they had given rise. Instead of the unbroken outline of the sea, an irregular surface of cultivated country began gradually to display itself; in the midst of which the majestic river we had noticed for some time back, appeared dividing the prospect, and losing itself in opposite directions amid the vapors that still clung to the summits of the hills, or settled in the valleys that lay between them. Across this river we now directed our course, and shortly after lost sight of it entirely, behind the gently swelling eminences by which it was bordered on both sides.

"It was about six o'clock,* during an ascent which occurred shortly after we had crossed this river, that the balloon having reached a considerable elevation, showed us our first view of the sun, and gladdened us with the prospect of a speedy approach of day. Powerful, indeed, must be the pen which could hope to do justice to a scene like that which here presented itself to our view. The enormous extent of the prospect*—the boundless variety it embraced—the unequaled grandeur of the objects it displayed—the singular novelty of the manner under which they were beheld—and the striking contrast they afforded to that situation and those scenes, to which we had so long and so lately been confined, are effects and circumstances which no description is capable of representing in the light in which they ought to be placed, in order to be duly appreciated. Better by far to leave it to a fertile imagination to fill in the faint outlines of a rough and unfinished sketch, than by a lame and imperfect coloring, run the risk of marring a prospect, which, for grandeur and magnificence, has certainly no parallel in all the vast and inexhaustible treasures of nature.

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* The time referred to here, and elsewhere, throughout this narrative, is that of Greenwich. Upon the completion of the voyage, a difference, amounting to about thirty-four minutes, was found to exist between the times indicated at its two extremes; the chronometers of Weilburg being so much in advance of those of London. This difference was occasioned by the easterly direction of our course, and the difference in latitude, to the extent of eight degrees twenty minutes, between the two places.

"This splendid spectacle, however, we were not long destined to enjoy; a rapid descent, which shortly after ensued, for a while concealed it from our view, and once more consigning us to the shades of night, which still continued to reign unbroken throughout the lower region of the air.

"Again we rose within the reach of this delightful prospect; and again did we lose sight of it, amid the vapors and obscurity that accompanied our descent; nor was it till we had three times made the sun rise, and twice beheld it set, that we could fairly consider it established above the horizon, and daylight complete upon the plane of the earth beneath us.

"From this time forward all our observation was principally directed to the nature of the country, and its adaptation to the descent which we had now resolved to effect the first fitting opportunity. To this step, the uncertainty in which we necessarily were, with respect to the exact position we occupied, owing to our ignorance of the *distance* we had come, especially determined us. For a long time past, the appearance of the country, so unlike any with which we were acquainted, had led us to entertain serious doubts as to whether we had not already passed the limits of that part of Europe where we might expect to find the accommodation and conveniences which our own comfort, and the safety of the balloon, imperatively demanded. This opinion, the large tracts of snow over which we had passed, during the latter part of the night, bearing a strong resemblance to all we had hitherto pictured to ourselves of the boundless plains of Poland, or the barren and inhospitable Steppes of Russia, considerably tended to confirm; and as the region we were immediately approaching seemed to offer advantages which, under these circumstances, we could not always hope to command, we resolved not to lose the occasion it so opportunely appeared to have afforded us. As soon as we had come to this determination, all preparations were speedily commenced for the descent; the guide-rope was hauled in (an operation of much labor, owing to the bad construction and imperfect action of the windlass), the grapnel and cable lowered, and everything got ready, that we might be able to avail ourselves of the first and fittest opportunity that might occur. To this intent, likewise, we quitted our exalted station, and sought a more humble and appropriate level, along which we continued to range for some time, and to a considerable distance; the yet early hour of the day, deterring us from completing the descent, in the fear of not obtaining that ready assistance from the inhabitants, which it is always the main object of the aeronaut, if possible, to secure. As the mists of the night began to clear away from the surface of the soil, we were delighted to perceive a country intersected with roads, dotted with villages, and enlivened with all the signs of an abundant and industrious population. One or two towns, likewise, of superior pretensions, were distinctly to be seen; giving promise of accommodation and advantages, which in our present emergencies, and under our present convictions, were not to be neglected. Accordingly, having pitched upon the spot most proper for the purpose, the valve was opened, and we commenced our descent. The place so selected was a small grassy vale, of about a quarter of a mile in breadth, embosomed in hills, whose sides and summits were completely enveloped with trees. Beyond this, on the opposite side, lay another valley of the same description; the only one visible for many miles, where we could conveniently effect our landing; an endless succession of forest scenery, completing the landscape in the direction in which we should have to proceed. Into the former of these we now precipitated our descent, with the design of alighting, if possible, in the centre, clear of the woods, that enclosed it on all sides. In these hopes, we were, however, disappointed; the wind suddenly increasing as we approached the ground, so much accelerated the onward progress of the balloon, that before the grapnel could take effectual hold of the soil, we had passed the middle of the valley, and sweeping rapidly over the ground, were borne close against the wooded declivity that flanked its eastern termination. To discharge a sufficiency of ballast to raise the balloon, and carry her clear of the impending danger, was the natural remedy. An unexpected obstacle to this operation here again presented itself: the sand, which forms the ballast, frozen, during the night into a solid block of stone, refused to quit the bag in the proportion required; and no time remained to search for one more suited to the occasion. Not a moment, was, in fact, to be lost; the valley was passed, and the branches of the trees, that clotted the opposing precipice, were already within a few feet of the balloon; the grapnel continued to drag, and no chance appeared of arresting her progress onward. In this emergency, one alternative alone remained, and the sack itself, with all its contents, to the amount of fifty-six pounds in weight, was at once consigned to the earth. In a moment, the balloon, lightened of so large a portion of her burden, had sprung up above one thousand feet, and clearing the mountain at a bound, was soon in rapid progress to the realms above. To counteract the consequence of this sudden accession of power, and avoid being carried beyond the reach of the second valley, which we have already described, as the only other available spot for our descent, the valve was again opened, and issue given to a large quantity of gas; sufficient, as was calculated, to check the course of the balloon, in time to enable us to attain the point to which all our views were now directed. A second time, however, were we doomed to be disappointed. No sooner had we completed this manœuvre, than by another caprice of nature, the wind suddenly abating, we found ourselves at once becalmed, and rapidly descending into the bosom of the woods that capped the summit, and clothed the sides of the intervening eminences. From this dilemma, we were only relieved by the timely discharge of a further portion of our weight; not, however, before the accelerated descent of the balloon, had brought us within a cable's length of the ground,* and almost in contact with the upper surface of the wood. Here, for a few moments, we continued to hover; the grapnel struggling with the topmost branches of the trees, and grasping and relinquishing its hold, according to the varying impulse of the slight wind that prevailed at our elevation. While in this situation, we perceived, standing in the path of the wood, two females, the first inhabitants we had noticed, lost in astonishment, and absolutely petrified with gazing upon so astounding an apparition. It was in vain we addressed them with a speaking-trumpet, in the hopes of procuring the assistance of some of the male population, which we conjectured could not be far off; the sound of our voices, proceeding from such an altitude, and invested with such an unearthly character, only augmented their astonishment, and added to their fears; they fled incontinently, and without waiting farther parley, sought the shelter of the neighboring coverts.

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* If we only reflect, that our position, when at this altitude, could enable us to behold objects at a distance of above one hundred and fifty miles on every side of us; had these objects been sufficiently great, or sufficiently striking to fix the attention, some idea may be had of the vast extent of our prospect, at this particular moment of our voyage. We shall then be seen occupying the centre of a circle, whose diameter extending to above three hundred miles in length, afforded us a horizon, the circumference of which, extending an equal number of leagues, comprised within its circuit an extent of visible surface, little short of eighty thousand square miles.

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* The length of the cable, to which the grapnel is attached, is about one hundred and twenty feet.

"After continuing for a few minutes longer in these straits, we at length reached the confines of the wood; when, resolving not to be again baffled in our designs by the treacherous inconstancy of the wind, the valve was opened to its fullest dimensions, and the grapnel taking hold shortly after, we came to the ground with considerable, though by no means, disagreeable rapidity.*

"As soon as the descent was completed, and the power of the balloon sufficiently crippled to permit one of the party to quit the car,† the inhabitants who had hitherto stood aloof regarding our manœuvres from behind the trees, began to flock in from all quarters; eyeing at first our movements with considerable suspicion, and not seldom looking up in the direction from which we had just alighted, in the expectation no doubt of witnessing a repetition of this, to them, inexplicable phenomenon.

"A few words in German, however, served to dissipate their fears and secure their services; when, as if eager by present assiduity to make amends for former backwardness, they absolutely seemed to contend with each other in their exertions to afford us assistance and execute our several behests. To this kindly feeling we endeavored to contribute by every means in our power. Our stock of biscuits, wine, and brandy, quickly disappeared, with a relish which the novelty of the journey they had so lately performed, tended no doubt, considerably to augment. The brandy, in particular, so much stronger than any they had ever before essayed, attracted their special admiration; and as they each in succession drank off their allowance, seemed by the exclamation of 'Himmlischer Schnapps,'* which accompanied every draught, as well as by the upward direction of their eyes, to denote the quarter from which they now became fully convinced a beverage so delicious could alone have proceeded. From them we now also learned where it was that we really had alighted, and for the first time became aware that we were in the Grand Duchy of Nassau, and about two leagues from the town of Weilburg, the nearest where we could expect to meet with the accommodation which the circumstances of the case rendered desirable.† Thither, therefore, we determined to proceed, and having procured a cart and horses for the transportation of the balloon, we quitted this, to us, ever memorable spot, and attended by an amazing concourse of persons of every rank, age, and sex, set out for Weilburg, which a few hours enabled us to attain.

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* Too much praise cannot be given to Mr. Green for his excellent conduct throughout the whole of this intricate pilotage. It is not by reading a mere description of the difficulties encountered, and the manner by which they were counteracted, that a correct judgment can be formed upon the proper merits of such a case as this; a further consideration is necessary; the knowledge that these difficulties did not proceed from the same source as the remedies by which they were defeated. In this light it is, that the conduct of our celebrated captain has a right to be criticised; the impediments were those of uncontrollable nature—the victory, and the means employed to secure it, were all his own.

† It was half-past seven o'clock when this occurrence took place, and our descent could be fairly said to be completed. The duration of our voyage may therefore be calculated at exactly eighteen hours.

"The fame of our adventure had, however, already preceded us. On our approach we found ourselves greeted with acclamations, and a ready welcome and honorable attentions awaited our arrival; all the resources of the town were immediately placed at our disposal; the use of the archducal manège was tendered for the occupation of the balloon; and sentries, more indeed as a guard of honor than protection, stationed at the doors and avenues leading to the place of its reception.

"Here then we resolved to remain until our future movements should be determined by the return of the letters we had dispatched to Paris immediately upon our descent. In the meantime we took advantage of this delay to open and inflate the balloon, as well for the purpose of drying and examining it, as to make some return for the obligations we were under, by contributing to gratify the curiosity of our hospitable entertainers. It would be scarcely credible were I to relate the interest wherewith the inhabitants seemed to regard this, to them, novel exhibition; the numbers that poured in to witness it from all quarters for many a league around, or the grateful acknowledgments with which they never ceased to overwhelm us during the fortnight it continued open to public inspection.

"Nothing in fact could surpass the courtesy and attention that we experienced from this simple-hearted and hospitable community during the whole period of our residence at Weilburg. Every one seemed to vie with each other in conferring favor and contributing to our entertainment; balls, dinners, concerts, and other amusements in honor of our adventure were given without intermission, and the congratulations of the city were presented to us by a deputation of the principal citizens, headed by their chief civil officer, in the form of a document duly signed and sealed by the competent authorities. Among the festive recreations to which our unexpected arrival at Weilburg gave rise, we must not omit to mention the ceremony of christening the balloon, which took place the day previous to our departure; the Baron de Bibra, Grand Maître des Eaux et Forêts, and the Colonel, Baron de Preen, being the godfathers; the Baroness de Bibra and the Baroness de Dungern the godmothers, on the occasion. The balloon having been inflated to the greatest size the dimensions of the place would admit, eight young ladies, in company with Mr. Green, entered within the gigantic sphere, and the name of 'The Great Balloon of Nassau' having been bestowed by one of their number, Mdlle. Theresa, the lovely and amiable daughter of the Baron de Bibra, accompanied by a copious libation of wine, the ceremony was concluded with a collation, consisting of the remains of our stock of provisions which had been unconsumed at the time of our descent.

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* The literal interpretation of the above expression is—"Celestial dram."

† The exact spot where the event took place was in a field adjacent to a mill, known by the name of Dillhausen, situated in the valley of Elbern, in the commune of Niederhausen, about two leagues from the town of Weilburg; already, by a curious coincidence, noted in the annals of aerostation as the place where the celebrated M. Blanchard effected his landing after an ascent which he made at Francfort in the year 1785.

"From such an universal display of hospitality and kindness it would be difficult to single out any to whom in particular our thanks are due: among those, however, whose station and circumstances entitle them to especial notice, were the Baron de Bibra, Grand Maître des Eaux et Forêts; the Baron de Dungern, Grand Ecuyer de son Altesse, pensionne; the Colonel, Baron de Preen, and their respective ladies; M. Hutschsteiner, Premier Conseiller de Médecine; M. Giesse, Premier Conseiller de Justice; M. Freydemann, Superior of the University, and M. Barbieux, likewise attached to the same establishment, together with a variety of others, the mere repetition of whose names would prove but a little recompense for the kindness we received at their hands. Through the Baron de Bibra, likewise, we took the opportunity to present to his Highness the Archduke of Nassau the flags* which accompanied the expedition, as a slight token of the hospitable reception we had experienced in his territories, with a request that they should be preserved in commemoration of the occurrence, among the archives of the Ducal Palace at Weilburg, where they now lie alongside of that which half a century before M. Blanchard deposited in like manner to perpetuate the remembrance of a like event.

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* Besides the usual national insignia, these flags presented a series of allegorical representations descriptive of the rise and progress of aerostation. Independent, however, of any merit which they might possess from their execution or design, there was one circumstance in their history which rendered them invaluable in the eyes of the aeronaut; they had already performed two hundred and twenty-one voyages in the air; having been the constant companions of Mr. Green's excursions ever since his fifth ascent, wherein he had the misfortune to lose his balloon and all it contained in the sea off Beechy Head.

"Thus ended an expedition, which, whether we regard the extent of country it passed over, the time wherein it was performed, or the result of the experiment for the sake of which it was undertaken, may fairly claim to be considered among the most interesting and important which have hitherto proceeded from the same source. Starting from London, and traversing the sea, which mere accident alone prevented from forming a more important feature in our route, in the short space of eighteen hours, we performed a voyage which, including only those deviations we have since been enabled to ascertain, rather exceed than falls short of an extent of five hundred British miles.

"It would be endless as well useless, to enumerate all the places of name or notoriety, which a subsequent examination of the map, aided by the reports of our appearance at different stations by the way, showed us to have either passed over or approached at some period or other during this extraordinary peregrination. A considerable portion of five kingdoms, England, France, Belgium, Prussian Germany, and the Archduchy of Nassau; a long succession of cities, including London, Rochester, Canterbury, Dover, Calais, Cassel, Ypres, Courtray, Lille, Audenaerde, Ath, Brussels, with the renowned fields of Waterloo and Genappe, Namur, Liege, Spa, Malmedy, Coblentz, and a whole host of intermediary villages of minor note, were all brought within the compass of our horizon, which our superior elevation* and various aberrations enabled us to extend far beyond what might be expected from a mere consideration of the line connecting the two extremities of our route.

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* The propriety of economizing our resources during the commencement of a voyage, the duration of which was a matter of uncertainty, occasioned our mean altitude to be rather under than over the extreme of aeronautical adventure. In the morning, however, as these necessities became less urgent, and we could afford to devote something to mere amusement, we frequently rose to an elevation of about twelve thousand feet, occasionally higher. At no time, however, did we experience the *slightest* effect upon our bodies, proceeding from the diminished pressure of the atmosphere. Nor, from what my own observations, and still more those of Mr. Green (whose experience in such matters far outweighs that of all the aeronautical world together), would lead me to assert, do I believe that any such effects as are currently attributed to this diminished pressure have any existence at all; at least, at any elevation to which any person has hitherto been enabled to arrive. The impressions experienced in the ascent of high mountains, which have no doubt led to the adoption of such opinions, and induced aeronauts with more regard to fame than veracity, to anticipate and assert effects they thought they would have experienced had they reached the elevation they fain would have the credit for, owe their existence to another cause, and proceed from the inordinate

"To all this there was but one drawback, in the time of year in which the experiment was conducted, and which by curtailing our daylight, devoted to the obscurity of night so large and interesting a portion of the expedition. Over this, however, we had no control; the constant occupation of the balloon for the purposes of public exhibition during the summer months, left no chance of its being procurable at a better season of the year, especially for a project such as ours, the determination of which as to time and distance was a matter of complete uncertainty. The excursion must therefore have been undertaken as it was, or altogether abandoned; of these alternatives Mr. Hollond unhesitatingly preferred the former.

"Ere concluding this hasty narrative, a word or two is required concerning the success of that experiment which formed the main feature as well as the chief object of the expedition. This success, I feel no hesitation in now declaring to be complete; and the discovery itself one, the entire result of which on the future progress of the art, it would be impossible at present to anticipate. With such an instrument as this there now seems to be no limit to the powers of aerostation; no bounds to its sphere of action. All the theoretical objections which a hasty consideration of the means might otherwise have suggested, experiment has now proved to be erroneous; and perhaps the best answer that can be given to those who might be inclined to question the practicability of its employment, or cavil at its effects, is, that by such means alone have we been enabled, without let or hinderance, danger, or difficulty, to traverse so large a portion of the European continent; descending at a distance of about five hundred miles from the place of our departure, with power enough to have enabled us, had we been so intentioned, to have continued our course throughout the whole circumference of the globe."

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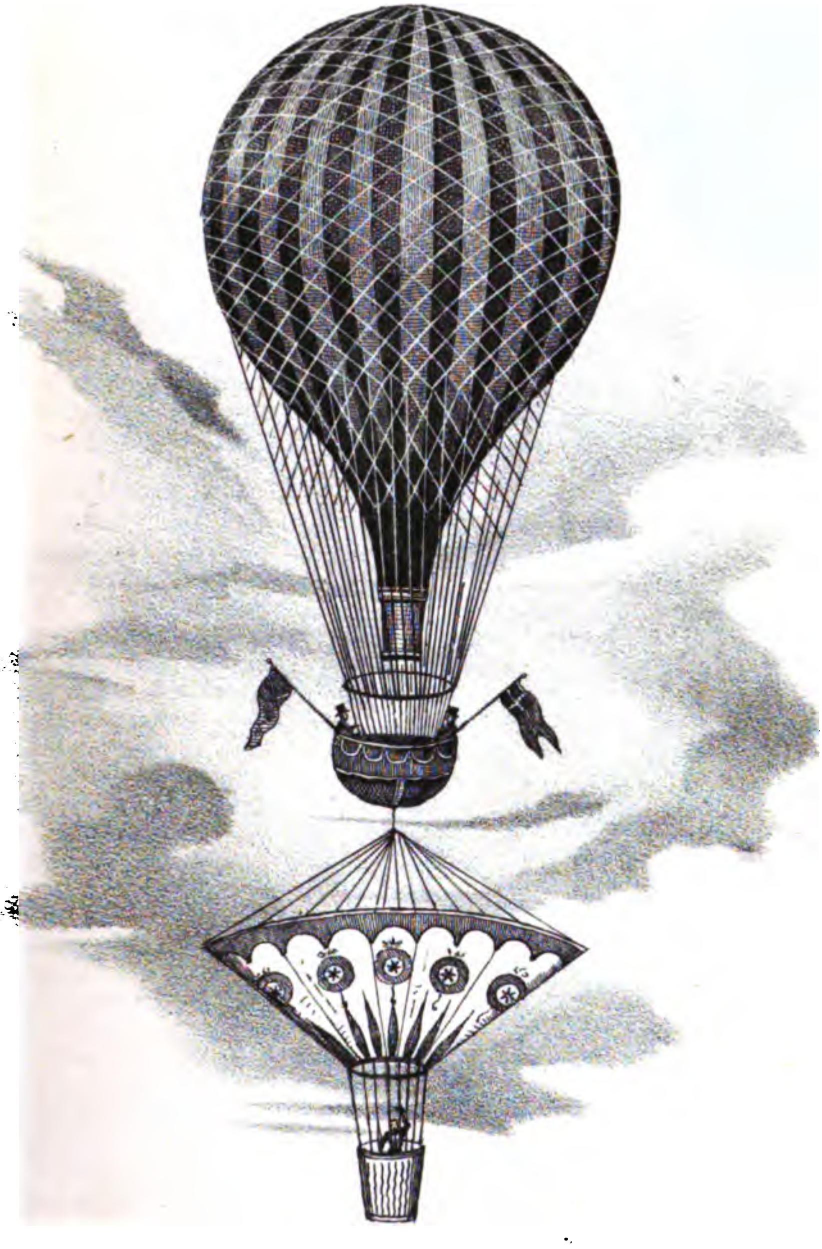
muscular exertion and its consequences upon the circulating system, developed in the attempt.

I am aware that great names appear in array against such an opinion; and likewise that nothing but the having arrived at the same altitude, without experiencing the same results, can authorize the flat denial of another's experience. If, however, at an altitude of three miles and three-quarters *no* symptom whatever is to be felt of those effects, which, at a *quarter of a mile* further evince themselves by such terrific consequences, the world is at least at liberty to exercise its own judgment upon the case.



P. S. Duval's Steam lith. Press.

MR. COCKING'S PARACHUTE.

CHAPTER XIX.

Fatal Parachute descent of Mr. Cocking, from the Nassau Balloon, at London—Account from the London "Penny Mechanic" of July 29th, 1837.

We regret to have to state that the experiment of the descent of the parachute, has terminated fatally to Mr. Cocking. In consequence of the announcement that he was to ascend in his parachute suspended to the great Nassau balloon, a great number of persons, among whom were many of the first nobility of the country, assembled in the gardens to witness the experiment. Without the gardens, upon Vauxhall bridge, and upon Millbank, the crowd was immense. It was in circumference 107 feet four inches. From the bottom of this machine, which was constructed of fine Irish linen, a basket of wicker was suspended, in which Mr. Cocking placed himself. The distance between the basket and the car in which were Mr. Green and Mr. Spencer, was between forty and fifty feet. The ascent of the balloon took place about twenty minutes before eight o'clock. When Mr. Cocking entered the basket of the parachute he was perfectly collected, and exhibited no appearance of want of nerve or indecision.

At twenty minutes to eight o'clock, everything being in readiness, and the parachute attached to the car of the balloon, the ascent took place. Nothing could be more majestic. The weight and great extent of the parachute apparently rendered the motion of the balloon more steady than on any former ascent, and the almost total absence of wind assisted in keeping the balloon in a perfectly perpendicular position. There was not the slightest oscillation; the balloon and parachute sailed through the air with a grandeur which exceeded anything of the kind ever before witnessed, and continued in sight for about ten minutes. A good deal of ballast was discharged almost immediately over the enclosure, after which the huge machine rose rapidly, but not so suddenly as to break the even current of its course. It was expected by those in the gardens that Mr. Cocking would have descended so near Vauxhall as to afford them a view of his descent. This was not the case. He was lost in the clouds, and the company were, for some time, left in conjecture, but certainly not in anticipation of the result of the experiment. A son of Mr. Gye was the first person who announced to our informant the fatal catastrophe. This gentleman followed on horseback, and arrived in a field, near Lee, in Kent, just in time to learn that the parachute had descended with such violence, that Mr. Cocking had lost his life in his experiment. The intelligence was not suffered to transpire for some time, in hopes that the account might be incorrect, and that Mr. Cocking might have only been stunned, or have fainted, it being remembered that something of this sort occurred on the descent of M. Garnerin some years ago. It was, however, very shortly ascertained that the intelligence was too true. It appears that the descent of the parachute was made over a field close to Lee, that, on approaching the ground, the parachute, from some cause or other, most probably from the hoop which distended the external circumference, being composed of a hollow tube of tin, collapsed, and consequently opposed no resistance whatever to the atmosphere, but turned over and over in the air, and came down with a frightful velocity. Mr. Cocking was not, as we are informed at present, thrown out of the basket, but he received a dreadful wound on the right temple, and had his ankle dislocated. He moved his hand once after his fall, but exhibited no other signs of life. Several country people, who were close by, procured a wattled hurdle, placed him upon it, and conveyed him without delay to the Tiger's Head Inn at Lee. He was immediately attended by Dr. Chowne, who was on the spot; but all medical assistance was unavailable. The arteries of his arms were opened, but it was to no purpose; life had fled. It is but justice to say, that this fatal result is attributable in no manner to any person connected with Vauxhall or with the balloon. Mr. F. Gye endeavored, but in vain, to persuade Mr. Cocking to have the hoop of the parachute of ash, but that unfortunate gentleman, from a notion that tin would be sufficiently strong and much lighter, refused to listen to his suggestion.

"The inflation," says Mr. Green, "commenced about twelve, under the able direction of the engineer to the London Gas Company, and was completed by five o'clock. Prior to the parachute being attached to the balloon, I caused a trial to be made, with the view of ascertaining whether the buoyancy of the latter was sufficient to carry up the former with safety. The result of this trial was, after some arrangements with respect to the ballast, of which I was compelled to give out about 650 lbs. in weight, in every respect, satisfactory. The abandonment of this large quantity of ballast I found to be absolutely requisite, in order with safety to commence the ascent. The balloon was then allowed gently to rise a sufficient height to be conveyed over the parachute; but in consequence of the great and unavoidable delay which was necessarily caused in affixing the two machines, the gas in the former became very considerably condensed, from a reduction of its temperature. It, thereupon, became a matter of compulsion that I should get rid of 100 lbs. more of the ballast, which I emptied out of the bags through a tube, constructed of canvass, and about fifty feet in length. The object in having this tube was, that any ballast I might deem it advisable to throw out during our voyage, should take such a course as would entirely clear the broadest expanse of the parachute. The connexion between the balloon and the parachute was at length completed by the rope of the latter being made fast to the liberating iron, by which Mr. Cocking was to free himself from the balloon.

"It is but justice to myself, I should here state, that I had on several occasions expressed my determination not to liberate the parachute from the balloon, upon the ground, setting aside any other considerations, that I might select a moment for the severance when Mr. Cocking was not altogether prepared or ready for his descent, and therefore, if any accident were to accrue to him, that I of course should be regarded as the responsible party, and the one to whom blame would naturally attach.

"Mr. F. Gye, everything being in readiness, about twenty-five minutes to eight o'clock, gave the signal for the whole of the apparatus to be released from its trammels, and we instantly rose very steadily, taking an easterly course.

"Mr. Cocking had always desired that we should ascend to an elevation of 8,000 feet, about one mile and a quarter, at which height he proposed to detach himself from the balloon, and to commence his descent. Finding, therefore, that our upward progress was very slow, I requested Mr. Spencer to discharge some more ballast, and he accordingly, threw the contents of a bag, weighing twenty pounds, through the tube already named. This proving of little avail, I directed a second and then a third bagfull to be got rid of by the same means.

"As soon as we had attained the height of 5,000 feet, I told him that it would be impossible to get up as high as he desired in a sufficient time for him to descend by the light of day. Upon this Mr. Cocking said, 'then I shall very soon leave you; but tell me whereabouts I am?' Mr. Spencer, who had a few minutes before caught a glimpse of the earth, answered, 'We appear to be on a level with Greenwich.' I then asked him if he felt himself quite comfortable, and whether he found that the practical trial bore out the calculations he had made? Mr. Cocking replied, 'Yes; I never felt more comfortable or more delighted in my life.' Shortly afterwards Mr. Cocking said, 'Well, now I think I shall leave you.' I answered, 'I wish you a very good night and a safe descent, if you are determined to make it, and not to use the tackle' (an apparatus, constructed under the direction of Mr. F.

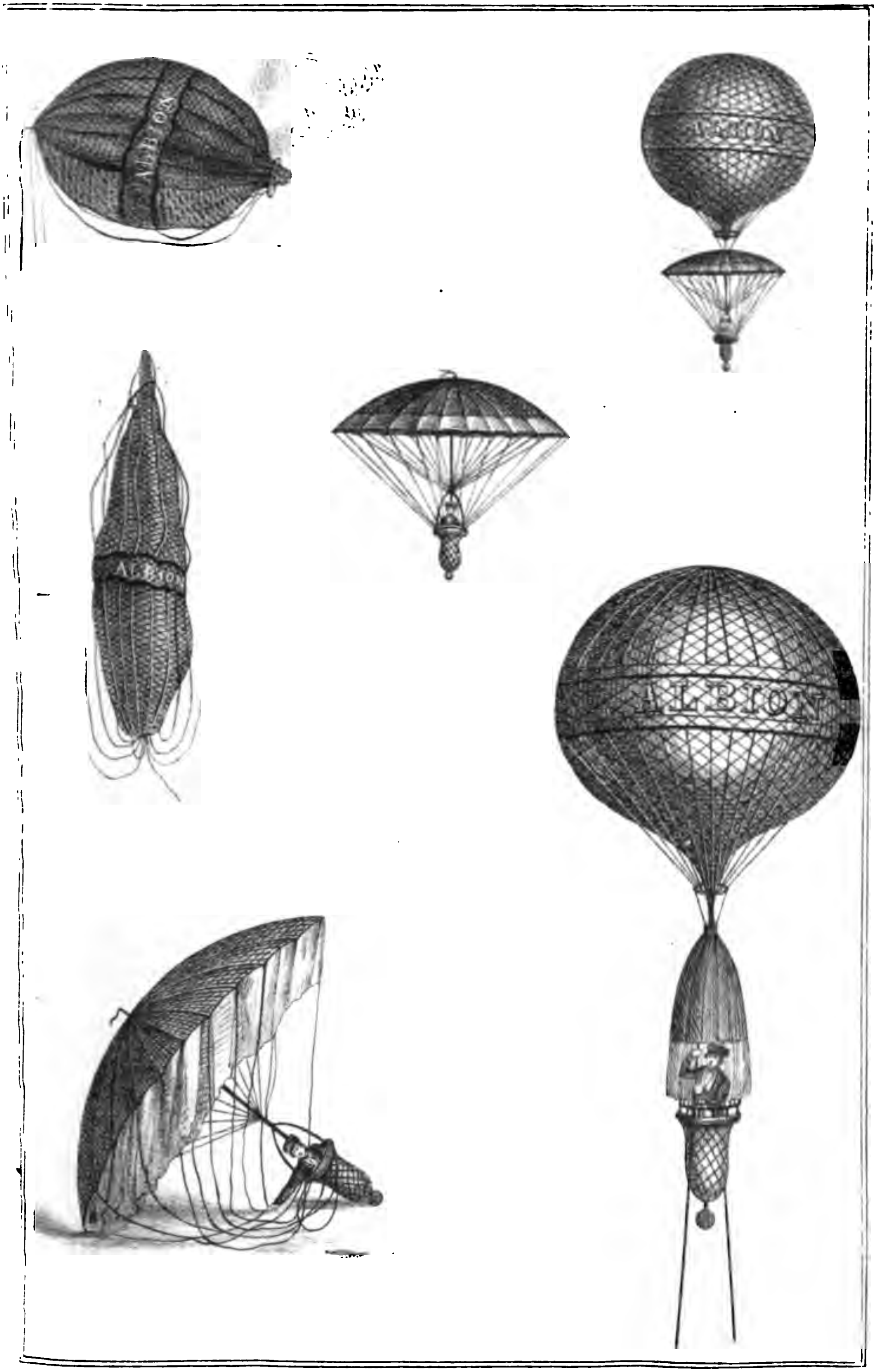
Gye, to afford us the facility of assisting Mr. Cocking to haul himself up into the car of the balloon if necessary). Mr. Cocking, to this question, made no other reply than 'Good night, Spencer; good night, Green.' At this instant I desired Mr. Spencer to take fast hold of the ropes, and like myself, to crouch down in the car. Scarcely were these words uttered, before we felt a slight jerk upon the liberating iron, but quickly discovered, from not having changed our elevation, that Mr. Cocking had failed in his attempt to free himself. Another, but more powerful jerk ensued, and in an instant the balloon shot upwards with the velocity of a sky-rocket.

"The effect upon us at this moment, is almost beyond description. The immense machine which suspended us 'between heaven and earth,' whilst it appeared to be forced upwards with terrific violence and rapidity, through unknown and untraveled regions, amidst the howlings of a fearful hurricane, rolled about as though reveling in a freedom, for which it had long struggled, but of which, until that moment, it had been kept in absolute ignorance. It at length, as if somewhat fatigued by its exertions, gradually assumed the motions of a snake working its way with astonishing speed towards a given object. During this frightful operation, the gas was rushing in torrents from the upper and lower valves, but more particularly from the latter, as the density of the atmosphere through which we were forcing our progress, pressed so heavily on the valve at the top of the balloon, as to admit of comparatively but a small escape by that aperture.

"At this juncture, had it not been for the application to our mouths of two pipes leading into an air-bag, with which we had furnished ourselves previous to starting, we must, within a minute, have been suffocated; and so, but by a different means, have shared the melancholy fate of our friend. The gas, notwithstanding all our precautions, from the violence of its operations on the human frame, almost immediately deprived us of sight, and we were both, as far as our visionary powers were concerned, in a state of total darkness for between four and five minutes.

"As soon as we had partially regained the use of our eyes, and had somewhat recovered from the effects of the awful scene in which, from the circumstances we had been plunged, our first attention was directed to the barometer. I soon discovered that my powers had not sufficiently returned to enable me to see the mercury, but Mr. Spencer found that it stood at 13,20, giving an elevation of 23,384 feet, or about four miles and a quarter. I do not conceive, from the length of time I had been liberating the gas, that this was anything like our greatest altitude, for we were evidently effecting a rapid descent.

"Recollecting the late hour at which we quitted Vauxhall, I



P. S. Duval's Steam lith. Press.

MR. HAMPTON'S ASCENT FROM CREMORNE HOUSE, CHELSEA.

now began to be anxious about the time, and on applying to Mr. Spencer, ascertained that it wanted not more than a quarter to nine o'clock. From this I was aware, notwithstanding, in our then position, we were blessed with a magnificent light, that on emerging from below the clouds, darkness would have assumed her sable hue over the earth, and that we should have much difficulty, therefore, in ascertaining the nature and character of the country, supposing us to be over the land, on which we must effect our final descent. I consequently became extremely anxious to make our way through the clouds as quickly as possible, which having done, we proceeded until we had reached within some 300 feet of the ground, when we found it requisite, from our inability to ascertain the nature of the ground, the whole country beneath us offering the appearance of thick woods, to cast out every article of ballast and movable matters, even to ropes and empty ballast-bags, in order to prevent us from coming in contact with what was supposed to be trees. After calling out for some time, and hanging out the grapnel, we heard voices in reply, and the parties speedily drew us to a safe place of landing which proved to be close to the village of Offham, near Town Malling, seven miles west of Maidstone, and twenty-eight from London.

"At half-past ten o'clock this morning, we quitted Town Malling, and it was not until our arrival at Wrotham, at which place I inquired whether they had heard where Mr. Cocking had descended, that I became acquainted with the unexpected and melancholy result of his experiment."

CHAPTER XX.

Mr. Hampton's ascent from Cremorne House, Chelsea, Thursday, June 13, 1839—And descent with his parachute—Description of his parachute—Aerial nocturnal excursion from Marseilles to Turin, by Mr. Arban.

"Mr. Hampton commenced his career as an aeronaut at the Eyre Arms Tavern, St. John's Wood, on the 7th of June last, where he met with great difficulties, but his judgment and intrepidity soon overcame them. It was on his ascent afterwards at Rochester, that he particularly displayed great presence of mind, and determined spirit, for, on that occasion, shortly after he had left the earth, the wind shifting, drove his balloon seaward, and it descended on the ocean, some miles from the coast: while in this perilous situation, he clung to his balloon, until rescued by a trading vessel, which landed the aeronaut, with his Albion balloon, at Whitstable. He ascended next at Canterbury, when the balloon not being sufficiently buoyant from a want of gas, the intrepid Hampton cut away the car tò lighten the balloon, and he ascended standing on the hoop to which the ropes that passed over the balloon were attached, and descended safely. In the course of last summer, Mr. Hampton ascended from Cremorne House, and also at other places, with the greatest facility, and descended without accident. At length he determined to outstrip all competition, by descending from his balloon by means of a newly-constructed parachute: the Montpelier Gardens, at Cheltenham, was the place chosen for this daring exploit; but the sad fate of Mr. Cocking, and the censure which the proprietors of Vauxhall Gardens incurred, by permitting the descent from the Nassau balloon, induced the owner of Montpelier Gardens to withhold his consent to Mr. Hampton's experiment; but in order to gratify the curiosity of the immense concourse of spectators that were assembled upon that occasion, he consented that the balloon and parachute should be exhibited, but to ascend no higher than sixty feet from the earth for fear of accident; when Mr. Hampton had reached this altitude, he could not resist the desire he had of putting his parachute to the test, and accordingly severed the rope which passed over his balloon, the two ends being held by men stationed in the gardens for that purpose. The astonishment of the spectators may be imagined, when they beheld the intrepid aeronaut majestically soaring towards the clouds. When about two miles from the earth, he determined upon descending; but, unlike Garnerin, who depended upon the atmospheric pressure, Mr. Hampton opened his parachute before he separated it from the balloon. The wind was very high. It appeared, when viewed from below, to be driven along at a great rate; and was, perhaps, the most boisterous Mr. H. ever experienced, the wind carrying him over the Leckhampton hills with great violence. He was not up more than twenty minutes, and descended at Cobberley. This ascent was in May, 1839.

DESCRIPTION OF THE PARACHUTE.

"The engraving shows the admirable construction of the parachute: the upper part is in the form of an umbrella, and about fifteen feet in diameter, with an ornamented border. The ribs are eight feet long, and expand from the top of the parachute to its extremities; they are formed of very thick whale-bone, strongly fastened by brass clamps; the ribs are connected to the copper tube by stretchers, made of bamboo. At the ends of the ribs curtains are suspended, two and a half feet deep; and, by an admirable contrivance, Mr. Hampton, when in his seat in the parachute, can, by a rope which runs from the car to the curtains, either contract or enlarge them, in the same manner as the sailor furls his sails. In order to guard against every possible accident, the car of the parachute is strongly guarded by iron hoops, to prevent the possibility of its receiving injury on its reaching the earth. Mr. Hampton, while in the car, can, by a pulley which runs through a copper tube (connecting the balloon to the parachute), open a small valve in the balloon, by which means he can let as much gas escape as he may think necessary immediately previous to his descending. When Mr. H. imagines enough gas is let off, he severs the rope which holds the parachute to the balloon (this rope also is conveyed to the balloon through the tube, which is eleven feet high, the altitude of the parachute); and he descends.

"The engraving represents the manner of Mr. Hampton's ascending, with the top of the parachute closed, and also as it appears when expanded; with the mode the gas escapes from the balloon; and his mode of descending, as also that of his balloon; and his reaching the earth at Cobberley.

"The ascent at Cremorne House on Thursday last, was a pleasing sight, not so repulsive to the feelings as that of the ascent of Mons. Garnerin, some years since.

"Shortly before the ascent, the rain impeded the progress of making the necessary preparation; indeed, for some time it was imagined no ascent would take place. At length, between eight and nine o'clock in the evening, the car was affixed to the balloon, and everything being ready, the undaunted aeronaut gently ascended, amidst the cheers of the assembled company. When he had been up a short time, he severed the rope which connected the parachute with the balloon, and descended in fine style, alighting on the Fulham-road in perfect safety.

"He was conducted back to the Gardens, accompanied by an immense concourse of people, who were not sparing of their approbation of his daring exploit."

AERIAL NOCTURNAL EXCURSION FROM MARSEILLES TO TURIN.

Mr. Arban, the aeronaut, ascended in his balloon from the Chateau de Fleurs (the Vauxhall of Marseilles) at half past six in the evening of the 2d of September, 1849, and alighted at the village of Pion Forte, near Turin, the following morning, at half past two, having accomplished the distance, about four hundred miles, in eight hours. The particulars of this interesting voyage, as related by Mr. Arban himself, are as follows: "I ascended from the Chateau de Fleurs, on Sunday evening, the 2d instant, at half past six. At eight I was over the wood of Esteret, where I ascertained I was at the height of 4000 metres. The temperature of the air was cold, but dry; my Centigrade thermometer marked four degrees below zero. The wind was south-west and sent me over Nice. For nearly two hours I was surrounded by very dense clouds, my cloak no longer sufficed to keep me warm; I suffered much from cold feet. I nevertheless determined to proceed and traverse the Alps, from which I knew I was not far distant.

"My provision of ballast was enough to raise me above the highest peaks. The cold gradually increased, the wind became steady, and the moon lighted me like the sun. I was at the foot of the Alps; the snows, cascades, rivers, all were sparkling; the ravines and rocks produced masses of darkness which served as shadows to the gigantic picture. The wind now interrupted the regularity of my course; I was occasionally obliged to ascend, in order to pass over the peaks. I reached the summit of the Alps at eleven o'clock, and as the horizon became clear, and my course regular, I began to think of supping. I was now at an elevation of 4600 metres. It was indispensably necessary for me to pursue my journey and reach Piedmont. Chaos only was under me, and to alight in these regions was impossible. After supper, I threw my empty bottle into the snow beneath, where possibly some adventurous traveler will one day find it, and will be led to conclude that another before him had explored the same desert regions.

"At half past one in the morning I was over Mount Misso, which I knew, having explored it in my first journey to Piedmont. There the Durance and the Po take their source. I reconnoitred their position, and discovered the magnificent plains of the mountain. Before this certainty, a singular optical delusion, occasioned by the shining of the moon upon the snow, made me at first think myself over the open sea. But as the south-west wind had not ceased to blow, I was convinced by this fact, as well as by others I had noticed, that I could not be over the sea. The stars confirmed the accuracy of my compass, and the appearance of Mont Blanc satisfied me that I must be approaching Turin. Mout Blanc to my left, on a level with the top of which I was, being far above the clouds, resembled an immense block of crystal sparkling with a thousand fires.

"At a quarter to three, Mount Vise, which was behind me, proved to me that I was in the neighborhood of Turin. I determined to alight, which I did without much difficulty, having ballast enough to go much farther. I alighted near a large farmyard, where I was surrounded by several watch-dogs, from whose caresses I was protected by my cloak. Their barking awakened the peasants, who were more surprised than frightened at seeing me. They admitted me to their house; informed me that it was half past two, and that I was in the village of Pion Forte, near Stubini, six kilometres from Turin. I passed the remainder of the night in the farm house, and in the morning the peasants accompanied me to the mayor, who delivered me a certificate, attesting my arrival, &c. After packing up my balloon and car, I set out for Turin, where I arrived at nine in the morning."

In this voyage the aeronaut sailed from west to east, from Marseilles to Nice, a distance of about a hundred miles. Crossing the mountains at a point where the Cottian Alps meet and form an angle with the Maritime Alps, he was swept along their eastern side in nearly a northern direction. Had he ascended higher, he would no doubt have been carried towards Genoa.

PART II.

COMPRISING A BRIEF HISTORY OF THE AUTHOR'S FIFTEEN YEARS' PRACTICE IN THE ART OF AERONAUTICS.

CHAPTER I.

Introduction of the subject—First American aeronauts.

As this part of the work is more especially intended to direct the student of aeronautics in his researches, and to enable him to attain that degree of perfection and consequent success in its practice which the art at present affords, it will be necessary to detail such of the hundred aerial voyages of the author as will throw the most light in that direction. Another science, so intimately connected with this as to be necessarily inseparable, may also be noticed in this connection, as far as the author's observations have extended, without being considered digressive. It is the science of meteorology. Everything which is calculated to improve the art, and afford facilities for its vigorous prosecution, becomes auxiliary to it, and should not remain unnoticed. The want of such information and assistance is known to no one better than to the author; therefore, its due appreciation, he trusts, will enable him to make this part of the book what he ardently desires it to be—a usefully instructive forerunner, bringing into the field of aeronautics a numerous and effective army of experimentalists, through whom the art will rapidly attain a practical position which will place it in advance of all other contrivances for transporting passengers to and from all places on the globe. The very easy manner in which any ordinarily skilful person will be enabled to build a balloon, and ascend with it, by the rules and instructions which will be given, will convince him that such expectations of its prosperity are founded upon plain and comprehensive principles. It will be discovered that ballooning is not that mysterious, hap-hazard, and dangerous art, which it is so universally believed to be, and which has no foundation in fact. And it will not be sufficient to make the subject merely plain enough to be acquired by any ordinary mind, but the reasons why so many more fail in minor experiments, than succeed, will also be given. Failures in the incipient prosecutions of experiments very often deter the student from *trying* to go further, while success in such cases is sure to fire the mind and genius of the operator with a spirit of encouragement and progressiveness. For this reason, particular instructions will also be given in the art of making and sending up toy balloons. This will be useful, because the same laws and principles govern these operations, as apply to those on a larger scale. Indeed, the toy experiments require a nicer perception of discrimination and calculation to make them terminate successfully, than do the larger operations. This very difficulty was the cause of retardation in discovering the means of elevating bodies in the air by atmospheric buoyancy. This same difficulty has, since the discovery made by the Montgolfiers, made many a disappointed investigator abandon the subject, from the belief that it was extremely precarious, and deficient in common principles, when but a slight hint in the right quarter would have enabled him to have gone on rejoicing.

None but an ardent laborer in the art can feel and appreciate the want of correct information, and its ready means of acquirement. What few receipts were extant, when the author commenced his first operations, for making elastic varnishes, and preparing the muslin or silk of which the balloon was composed, did more to retard his progress than if he had never seen them, because they were not from practical hands. This difficulty was only overcome by close application and a gradual research of seven years' practice. In this part of the construction of balloons, an important discovery—the making of an elastic varnish—will be laid before the reader. Its great merit consists in having no affinity for oxygen, and yet a quickly drying property, retaining its elasticity under great changes of temperature, and being free from the danger of spontaneous combustion, thereby giving great durability to the balloon, and also relieving the aeronaut from the trouble and perplexity caused by the adhesiveness so common to balloon varnishes. Indeed, everything pertaining to the construction of balloons and their requisite paraphernalia, shall be laid down in a plain, practically comprehensive manner, in its proper order, so that any one who can read may be able to understand it.

CHAPTER II.

First balloon ascension in the United States—Durant, the first American aeronaut—The author's first ascent—Details of the trip—Conclusions.

The first aerial voyage in the United States was made by M. Blanchard, a Frenchman, in January, 1793, from Philadelphia, at which Gen. Washington was a spectator. Gilleo and Robertson, also Frenchmen, were the next after Blanchard. No Americans were engaged in the business until Mr. Durant, an ingenious citizen of New York, took it up after Robertson. He made a number of aerial voyages, which were shortly followed by others made by new adventurers in the art.

When I first conceived the idea of making a balloon, I had never seen an ascension with one, nor had I any practical knowledge of its construction. It will, therefore, be interesting, as well as instructive, to give a particular history of my first experiment in detail. In the spring of 1835, living at that time in the city of Philadelphia, I resolved to build a balloon on a very economical plan; as I intended merely to gratify my desire of sailing aloft to enjoy a prospect that I had ever considered must be grand and sublime, I did not wish to incur any more expense in the construction of a machine, than was essentially necessary to such a consummation. My first step was the study of the atmosphere—its nature and its buoyant power. This opened a field of speculative philosophy, which was well calculated to cause me to rub my forehead, and strain my imagination, being, as I was, a novice in such studies. This naturally led me into the study of pneumatics, and hydrostatics, and I was, indeed, amazed at the immense power the atmosphere possessed in elevating bodies or vessels which were exhausted of air, and filled with a substance easily to be made, that would be from twelve to fourteen times lighter than air. This capability of the atmosphere in elevating bodies seemed to me of such enormous extent, that I was almost led to the belief that the very earth upon which we live was floating in an immense elastic medium, on the principle of a balloon. The very moderate size of four hundred feet diameter of a balloon would make it capable of raising two million and ninety thousand pounds, when inflated with hydrogen gas. This would raise up and carry off thirteen thousand men of one hundred and fifty pounds each.

No wonder that the citizens of London became alarmed during the French consular war, when they mistook the appearance of a vast flock of birds coming towards the metropolis, for Napoleon's army, apparently coming down upon them with this (then new) contrivance.

After I had made myself tolerably well acquainted with the science that governs the art of ballooning, I next sought information upon the *probability* of success, should I undertake the experiment. My first step in this matter was to consult a number of scientific gentlemen, by which means I might learn whether my deductions and conclusions squared with those whom I knew to possess the proper information. The result of this determined me to go on. Accordingly, the material for the balloon was procured, which consisted of fine domestic muslin, such as is used for shirting, commonly denominated "long cloth." It was requisite that this should be made air-tight, or as nearly so as possible, with a varnish that should neither crack, nor become adhesive, when dried. Having a practical knowledge of the composition and nature of varnishes, I saw in this no inconsiderable difficulty to be overcome. Although the receipt books abounded with prescriptions of elastic varnishes, and even a few specially for coating balloons, it was evident to my mind on perusing them, that they were mostly the productions of theoretical minds, or at least were not written by practical operators.

The varnish most likely to answer of all that came under my notice, seemed to be that of "bird lime." Of this article I procured eight pounds, which, together with the requisite quantity of linseed oil, and the common metallic driers used in oil varnishes, composed the varnish for the balloon. The muslin was hung up in the same manner as it is hung up about factories—that is, by its one edge on hooks, hanging loosely down. It was thus coated over and dried in the sun, and then coated a second time. After the second coat had dried, which took nearly a week, it being in winter, it was cut into properly shaped segments and sewed together. This being done, it was now taken into a large room and filled with common air, and coated a third time. This stopped up the needle holes and to some extent perfected the coating of the whole machine, for, upon trial of its capability to hold air or gas, it seemed impermeable enough to answer the purpose of a mere aerial pleasure ride. This method of trying its quality consists in merely filling it with common air, and suffering it to remain for a day or two in this condition, to see what amount it loses. This machine being twenty-eight feet in diameter, and when half filled with common air, would lose about twenty per cent. of it in twenty-four hours, so that its real loss when filled was equal to ten per cent. in twenty-four hours, and this was far from what a good balloon ought to be.

The balloon thus finished, the next step was to procure a network for its rigging, by which the car and other paraphernalia were to be attached. This was composed of cotton seine twine, and knit by a woman who was accustomed to knit fish-nets, and was the best part of the whole machinery. The car consisted of a basket about two and a half feet in diameter at the bottom, gradually expanding to its top, and was about three feet eight inches deep, by the by a very awkward shape, as the sequel proved it to be.

Thus provided, the next arrangement was the procurement of an inflating apparatus, and materials for generating hydrogen gas. Fifteen casks of a hundred and thirty gallons capacity each were used as retorts. These were arranged in a semi-circular form around a gas receiver and made to communicate with it by the gas bubbling up through a head of fifteen inches of water through recurved tin tubes, which connected each retort with the receiver. This being got in readiness, nothing remained but to put the machinery in operation and make the experiment. Having now been at considerable expense, although the strictest economy had been observed, my financial condition did not allow me to undertake the additional expense of materials for inflation, unless it should be based upon some remunerating arrangement. It was suggested by some friends, that a public exhibition of the contemplated ascension, at fifty cents admission, would meet the expenditures of inflation. This all appeared very reasonable to me in itself; but from the intimations that had already come to my knowledge, of a want of confidence in the public as to my ability of making a successful experiment, it somewhat discouraged me in such an undertaking. Not that I really doubted a successful termination of the affair under a fair trial; but because balloon ascensions, from repeated failures in their attempts, and mobs, had become synonymous ideas with a great portion of the people who were attracted by them. Even many of my intimate acquaintances shook their heads in doubt as to its feasibility; indeed, as to its possibility, looking on it, as the mass of the people did, as a precarious, mysterious, and not easily to be accomplished experiment. The simplicity of the science itself, together with the confidence of those of my scientific friends whom I had consulted, and who seemed to have as little doubt of its possibility as they had of that of running a steamboat or locomotive engine, was enough to outweigh the forebodings of the timid and skeptical, in my mind; but still, this did not answer to allay popular excitement, which must certainly accompany a public balloon ascension at even that day.

However, all things considered, I decided upon the plan of a publicly advertised ascension, and as a first experiment too, to take place at the corner of Ninth and Green streets in Philadelphia, on the 30th day of April, 1835. This announcement brought down upon me from many of my friends, all the forebodings that timid minds could predict on the anticipation of a balloon riot. You are going right in amongst the butchers, said some, and they are a very determined, rough class of people, besides many other imaginative terrors, of which, had I believed the one-tenth of them, I should have been appalled and driven from my determination. But I reasoned in this way, that if the butchers were so formidable a people, they would be equally effective in protecting me in any lawful calling in which I might be engaged. And so I found it to be the case, too, while fixing up my apparatus, which occupied me several days, during which time I became acquainted with many citizens of the district in which I had announced to ascend, and among them were a number of the victuallers of the place, who tendered me the warmest assistance and encouragement, believing, as they did, that I was at least serious and honest in my intentions, if not capable to accomplish them.

The 30th of April turned out to be a blustery stormy day, and these very people who were accounted as not willing to take any excuse for a postponement or delay of a balloon ascension, were the first to advise me to put it off until the 2d day of May, which was accordingly done. This turned out to be a day in every respect favorable to the experiment. The balloon was brought upon the ground, which, with the car and net-work, weighed 186 pounds. The inflation was commenced, and everything went on steadily for three hours, when the time for the ascension arrived, it being announced for four o'clock in the afternoon. The balloon was little more than half full, which caused many to think it would not be able to carry its freight; but, as the balloon was twenty-eight feet in diameter, half its capacity filled with hydrogen would make an ascensive power of 375 pounds, so that the question with me was, whether it *was* half full. Upon consulting Professor J. K. Mitchell, who was present, and who was my friend and adviser in this matter, he concluded it was sufficiently inflated to carry me up. By the time the car was harnessed on the balloon rigging, another half hour passed away, without the least manifestation of discontent by those who were inside the arena, but with no inconsiderable tumult among the dense crowd that had assembled round the outside, and even they seemed to be more moved by anxiety to learn the result, than a desire to mob the balloon, for, as I mentioned before, they too, had come to the conclusion that "*he will go up if he can.*"

Everything being apparently in readiness now, I stepped into the car of the balloon, took in about fifteen pounds of sand in two small sacks, a barometer and thermometer, and then attempted to ascertain the precise ascensive power the balloon possessed. But, as everybody around me knew it was my first experiment, and as none of the most considerate could get near enough to the machine to enable me to poise it properly for starting, and those who had hold of the ropes and car seemed to labor under the belief that I was not over-anxious to leave the earth, because they could not understand my intentions when desiring them to hold on to the machine until I had it properly graduated, I was of course bound to submit to their proceedings. Thus, before I could even properly arrange my instruments or make the least calculation of the balloon's upward power, as I could not get them to let it swing by a cord which I had attached to the car for that purpose, some crying "send him up," with powerful efforts on their part to suit the action to the word, while others were equally determined to hold it down, which struggle, however, terminated in a few minutes in favor of the *ascendant* party; with a considerable projectile force added to the balloon, I was in a few moments grazing the chimneys of the neighboring buildings. My first act upon this was to get rid of the two small sacks of sand, which relieved the balloon sufficiently, in addition to a rebounding force it got by the car striking the top of a chimney, to send it over a vacant lot in which it descended. An individual who happened to be on the spot took hold of the car at my request, and held it steady until I handed out the instruments to another who immediately appeared, and in a few moments an immense crowd assembled round the balloon, it being but three or four hundred yards from where it had started. The scene here presented a mixture of excitement and confusion, without the least disposition of violence towards the balloon, and yet of such a nature as to make it morally impossible to do anything with system or order, that it required an almost superhuman effort to make oneself heard in any words to that effect. After having handed out my instruments, as also my boots and coat, which, together with the sand, amounted to at least eighteen pounds, I roared at the top of my voice, "For God's sake, gentlemen, will you give me a chance to make the ascension?" This seemed to have the desired effect, and a number of voices responded to it in a desire to learn my wants. I told them it was necessary to give me a free space for the car to float in with but one person to hold it, and if it would not show a tendency to ascend without being pushed up, as it had been in the arena, it was impossible to make the ascension without putting more gas in the balloon. A circle was immediately formed; the car was clear; the person in question had his hand on it; it showed unmistakeable symptoms to rise, as it required considerable effort to hold it down; and without further delay I ordered him to let go, and before I could fairly say good-by, gentlemen, the aerial ship was speeding me rapidly above the reach of obstructions. Now followed a scene worthy the pen of a poet. The first second or two of the balloon's ascent caused a stillness in the immense mass of people below that seemed as though they were fixed immovably to the spot, when all of a sudden, the very air began to reverberate with the shouts that followed. The multitude appeared to be as much rejoiced at the result as I possibly could be myself; and I must confess it was one of the happiest moments I ever experienced in my life, for, but a few minutes before, from the circumstances attendant, the success of the experiment for the time seemed to rest upon a very doubtful contingency—that of getting back to the inflating apparatus. Up, up I soared, almost perpendicularly, to the distance of several thousand feet, when a gentle breeze wafted the machine in a south-westerly direction—the balloon still rising—until it reached a point at the intersection of Market street and the Schuylkill River, which is about one mile and a half from where it started. Here it became stationary, or nearly so, and just at a point where the balloon had reached an altitude equal to its ascensive power, where was also a point of two currents of air traversing each other; the one from the north-east, which wafted the machine thither, was here traversed above it by a current from the west.

Having now lost sight of the great throng of people that surrounded me at starting, and standing over a large city, at least a mile above it, solitary and alone, with a low melancholy murmuring noise rising up from it; the balloon slowly writhing and twisting, as it were, between two contending currents, causing a fluttering breeze around me, while I was standing in the car without hat, coat, or boots, looking around, below, above, and in every direction, strange emotions pervaded my mind. Grandeur had ever been a delightful theme to me, but this was more than grandeur. All the higher faculties of the human mind became gradually aroused; I was gently awakening from a magnificent dream, casting my eyes upon a scene of reality that appeared far more grand and magnificent than the dream itself; strange feelings were passing through my mind; I felt composed in body, but there was an indescribable commotion agitating the inner man, and it was some time before I reasoned the soul and body into their natural state of equilibrium. Although the atmosphere at this height was cold, the perspiration now began to roll from my forehead in large drops. By a comparison of the previous few hours with the present position then occupied, I became enabled to look and reflect in a more natural spirit, but still, the vastness, grandeur, and sublimity of the scene around me kept me in a mood far different from what I had ever before experienced. The mind appeared to expand itself commensurately with the magnitude of the scene that surrounded it. Here was an immense community of human beings swarming underneath my feet, sending up a humming buzz from their apparently condensed cells; there, the ample folds of the Delaware were rolling themselves into the heaven-curtained clouds of the distant horizon; above me stood the huge distended balloon, swelled, as it were, in pompous pride of its exalted position, floating like an independent sphere, with its single inhabitant, in the great ethereal ocean of the universe. It was a soul-inspiring scene, and one that will never be erased from my mind as long as its faculties shall live.

The balloon was retained in the eddy it had reached for several minutes, and until it was lightened sufficiently to rise above it, which was done by cutting off and throwing overboard a heavy flower-wreath which had been twined around the car. These flowers, as they fell from the car, were taken for birds by those who watched the progress of the balloon with telescopes, as I was afterwards informed. Besides this, the car was hanging so near the balloon, that I was enabled to detach the tin tube which was in the neck of it, and which, in this instance, was unnecessarily heavy, but, as the disposal of the wreath had lightened the machine sufficiently to enable it to rise above the eddy, I did not throw it overboard at that point, and upon consideration found it would not be safe to do so until I should get over a place where no human beings would be endangered by its descent. After the balloon had risen above the lower current, and the eddy, which invariably exists between two currents, it took off in a direction eastward, nearly on a line with Arch street. This I was enabled to tell by the map-like appearance of the city, the market-houses being in the next street south of it, which made a good mark to distinguish the streets by. As I passed slowly over the city, its murmuring noise rose up in modulations of variable intensity, giving it a melancholy musical effect, in some measure resembling the sound of an Æolian harp. The current from the west being very gentle, it required full twelve minutes to carry the machine from the Schuylkill to the Delaware, during which time I feasted my eyes upon the panoramic scenery of the city and its precincts, occasionally running the eye along the serpentine folds of the Delaware to where it was lost in the clouds which skirted the horizon all round. The Schuylkill seemed of too little interest, when viewed from that height, in comparison with its larger neighbor. When I reached the Delaware I threw overboard the neck-pipe of the balloon, which made a rushing sound in its descent until it splashed into the water, which I heard distinctly, although I was over a mile above its surface. As I crossed the Delaware, the view up and down for a distance of twenty or thirty miles each way, was picturesque and grand beyond conception, and yet more natural in appearance than land scenery. This effect of the river scenery caused a degree of composure in my mind, which, until now, had been strained far beyond a normal condition, that enabled me to investigate and observe in a more ratiocinative manner. Before this, amazement was the only resultant of all observation on this magnificent planisphere. Although the boats and ships on the river looked very diminutive, still, the scene had the miniature appearance of a natural reality. This was not the case in taking a grand and general view over the whole visible plain beneath; for, in such an observation, a regularity and exactness developed itself in the scene, which gave it more of an artificial than a natural aspect. A perfectly formed circle encompassed the visible planisphere beneath, or rather the concavo-sphere it might now be called, for I had attained a height from which the surface of the earth assumed a regularly hollowed, or concave appearance, an optical delusion which increases as you recede from it. At the greatest elevation I attained, which was about a mile and a half, the appearance of the world around me assumed a shape or form like that which is made by placing two watch crystals together by their edges, the balloon apparently in the central cavity all the time of its flight at that elevation; the river each way, cut off at the intersection of the upper and lower concavo-spheres. At one time this crevice, if I may so term it, was apparently filled in with clouds all around, while at the close of the voyage the visible horizon was clear of them, which gave it, as I before stated, a very artificial appearance. I could not help but think at the time that, had the Roman Inquisition which made Vincent Galileo recant his doctrine of the rotundity of the earth, in favor of the planispheric theory, occupied my position, they would have insisted to his swearing that our earth was hollowed or concave on its outer surface, instead of flat, as they made the philosopher swear it was.

After I had crossed the Delaware and reached a point five or six miles on the Jersey side of it, I made preparations to descend, as I discovered the balloon was now gradually sinking from the loss of gas through its imperfection, which made me feel as sorrowful as Adam when he was expelled from the garden of Eden. After being in the upper regions of the atmosphere one hour and a quarter, I made a safe descent near Haddonfield, a village about nine miles distant from Philadelphia, and returned home that evening, where I received the congratulations of many friends.

Now that I had really enjoyed the pleasures of an aerial voyage; viewed the earth from a point in space which was isolated and unobstructed; feasted my eyes upon one of the most interesting and richest scenes that mortal man could imagine, and had acquitted myself in an experiment publicly announced in a creditable manner, it might have been supposed that my desires and ambition in this matter had been fully satisfied. But, such was not the case. I had now visited the shrine of intellectual grandeur, and its attractions were seductive. I had dreamed a magnificent dream; which, I felt convinced, could be realized. Such were my reflections, when recurring to this event. Although many of my friends desired me, in the most persuasive manner, to give up the idea of repeating the experiment, looking upon it as an extremely dangerous business, I resolved in my own mind to pursue it as long as it afforded me the same enjoyment which I experienced in my first essay. Besides, I formed an opinion that aerial navigation was destined to move with the progressive order of the day; and I felt it a duty devolved upon me not to let it sleep for the want of active investigation, however slow its improvement might be. Such considerations induced me to go on, and on I did go, as the sequel will show, for fifteen years already, with, at least, well-founded hopes of its approaching general usefulness, if not with considerable improvement in the way of having simplified the art, so as to bring it within the reach of experimenters at a reasonable cost and a certainty of success, that must ere long give it a valuable feature.

CHAPTER III.

American aeronauts—Death of James Mills—Difficulty in the construction of balloons—Author's second experiment—Failure, and its cause —Hints to aeronauts in such predicaments.

About this period (1835), a considerable number of experimentalists in ballooning made their appearance in various parts of the United States; but, unfortunately for the progress of the art, the most of them were not philosophically acquainted with the subject. For this reason so many failed in the simple process of a balloon ascension. This had a tendency to confirm the opinion which previously existed, that to make a balloon ascension was a very mysterious and difficult matter. The most successful of this numerous corps of aeronauts, were Mr. James Mills, of Baltimore, Mr. Richard Clayton, of Cincinnati, and Mr. William Paullin, of Philadelphia. These gentlemen made a great number of ascensions in various parts of the Union, and Mr. Paullin extended his operations into South America and the West Indies. Mr. Mills died at York, Pa., while having announced his eleventh ascension, and it was generally reported that he had come to his death by suffocation from gas. This opinion originated from the fact that he was found dead in the room where he had his balloon, and where he died from apoplexy while in the act of repairing it.

All these aeronauts labored under the same difficulty which gave me so much trouble and perplexity during the first five or six years of my operations—the want of an elastic varnish, which should at once combine the qualities of impermeability, elasticity, and non-adhesiveness. From this difficulty I did not suffer so much with the first balloon I made, because it was composed of domestic muslin, a fabric which is more capable of absorbing varnish than silk is; but it gave a disadvantage in the immense weight of the machine, being four times that of one of silk of the same dimensions. Cumbersome and imperfect as this first machine was, I used it in six experiments before I abandoned it. My second trial with it was from the same spot where I had made the first, but I failed in getting the balloon sufficiently inflated, from an accident that occurred while filling it, from the breaking of a carboy of vitriol, which splashed some acid over the balloon and damaged it so much, that it could not be repaired sufficiently on the ground to make it answer for the ascension then to be made. This would not have occurred had the balloon been further from the inflating apparatus, which is easily done by using a longer conducting hose to pass the hydrogen from the receiver to the balloon, a precaution which I afterwards invariably adopted. Upon this accident, when all efforts on my part had failed in overcoming the difficulty, I candidly stated to the audience assembled what the reality of the case was, and when they saw that my heart was as full of sorrow as the balloon *should* have been full of hydrogen, they not only sympathized with me, but unanimously resolved not to take back the fee of admission which I proffered them, and, moreover, cheered me up by requesting me to repair the balloon and try it again on some other occasion.

This was all done in the arena in a spontaneous, but systematic manner, and I mention it as an instance to show, that, at even a great gathering of people to witness a balloon ascension, they are not unreasonable nor evil disposed towards the aeronaut, when they are convinced that he is guiltless of any intention to deceive them. And when the aeronaut is in such a predicament it is an easy matter for himself, or any friend of his, to explain things satisfactorily, which is always better than to look upon the public as an uncivilized and vicious throng, and under such delusion attempt to skulk from anticipated vengeance which has no real existence. The very act of attempting to sneak from such responsibility carries with it a degree of suspicion calculated to inspire mistrust, and has caused the destruction of more than one aeronaut's property, when a little common sense would have saved it, and his credit too.

Having devoted this short chapter mainly to an unsuccessful experiment which had been attempted as a public balloon ascension, it may be very properly concluded, by advising all experimentalists in ballooning, and it pertains equally strong to all progressive experiments, whether for public amusement, or pioneering trials, to never promise more than they *really* intend to accomplish. The observance of this rule has saved me a good deal of trouble.

CHAPTER IV.

Author's third experiment—Perilous situation—Balloon bursting—Descent and its incidents—Woman more presence of mind than man—Two more experiments—Sixth and last experiment with muslin balloon—Unfortunate result—Near proving fatal.

THE third experiment I made is one full of interest as well as instruction to the student of aeronautics. And as the main object of this part of the work is to lead the practitioner into the fullest knowledge of the art, a detailed account of the experiment and its circumstances should be related. On this occasion I attained the greatest elevation in the whole course of my practice; and it must be borne in mind that it was the largest balloon used in my whole fifteen years' experience. Upon the size of the balloon depends the altitude to be attained, and this machine, requiring to be but half filled in order to carry its passenger with considerable ballast, was capable of attaining a height in the atmosphere where the air is but half the density of that on the surface of the earth. Such a height was attained on this occasion, and, although the ascension was a most complete and satisfactory one to all who witnessed it, there were defects in the rigging of the balloon which developed themselves in the high and rarefied regions of the atmosphere, that placed me for a while in a very perilous situation. The ascension was made from the town of Lebanon, Pa., on the 4th of July, 1835, and the weather was extremely warm.

At three o'clock P. M. I left the earth with a breeze from the north-west. In a few minutes after, a panoramic view of innumerable villages, with the broad dazzling sheet of water of the Susquehanna, was unfolded to the view. I crossed the Reading and Harrisburg turnpike at the first gate below the town, and although I started off with an ascending power that raised me more swiftly than was the horizontal velocity of the wind, I was induced to part with a bag of sand of about six pounds weight, as a proffer to the toll-gate keeper, who very humorously hailed me to pay toll as the balloon passed over his gate. This caused the balloon to rise with amazing rapidity, rushing up through the strong horizontal wind, which was blowing with a speed of at least thirty miles per hour, and giving the occasion much the appearance and spirit of that in which a fiery charger is dashing along in mettled pride, heeding no restraint. This soon brought me in contact with a thick hazy mist, which was entered, and in a few moments passed. Above this were a clear sky and brilliant sunshine, but so cold now, that my hands became numb, and a painful earache seized me. The balloon was still ascending rapidly, and my next impression was to discharge gas and lower into a more congenial climate, but in this I was foiled, and up boomed the buoyant courser with unabated career. The cord by which the valve was worked was sufficiently strong to perform that office, but no allowance was made in its appropriation to unforeseen necessities—such as slight entanglements with other parts of the balloon rigging—getting into folds of the flaccid part of the balloon—which latter liability occurred on this occasion, and deprived me of the use of that all-important regulator.

Having now got far above the mist, and not less than three miles above the earth, in a temperature of 43°, having been within twenty-five minutes transferred from a warmth of 94°, which the thermometer indicated when I left the earth—the world below scarcely visible from the intervening discolored stratum of air; my ears buzzing like a bee-hive, which for a while I took to be a commotion of the gas in the balloon endeavoring to escape through its tightly distended envelope; the valve rope broken off inside the machine; the aerial ship still bounding and gyrating upwards, I felt a degree of excitement that can be better imagined than described.

All this difficulty arose from a want of practical knowledge in the art which must be acquired in this, as in any other business, before we can avoid consequences arising from such deficiency. In the first place, the valve rope was too frail in this machine. Instead of a substantial cord (cod-fish line I find the best) this was only common seine twine. The car was also rigged too near the balloon; this may have been observed already by the intelligent reader, where it is mentioned in the account of the first voyage, that the car was so near the balloon that I was enabled to untie the neck-pipe in the lower orifice of it. On this occasion I had it hanging at least three feet lower from the balloon than before; but when I got to a height in the atmosphere where the gas sustained but half the pressure it did at the time of leaving the earth, it naturally dilated accordingly, and all the part of the balloon that was flaccid when it started was now required for its increase of bulk. For this increase the space within the cords and net-work between the equator of the balloon and the concentrating hoop above my head to which the car was hanging, was insufficient. Having no way to let off gas, even the lower orifice of the balloon containing the neck-pipe, which answers for a safety valve when properly rigged, was doubled up between the concentrating hoop and the lower side of the balloon, which was now swollen to its utmost tension. I endeavored to reach the lower part of the balloon with a knife, but by straddling across with my feet in the open-work of the basket, it could not be reached by at least two feet. From the hissing noise of the gas which was making its way through the small channels of the compressed neck of the balloon, I knew that something must give way soon. As I did not know at that time that so large a surface of fabric as is contained in a machine of that size, would inevitably meet with friction enough, in falling through the atmosphere, to bring it to a velocity where an acceleration must cease, and *that* at a point where its speed will not cause serious consequences from contact with the earth, I was apprehensive that it *might* be my last voyage.

In another moment a report like that of suddenly bursting an inflated paper bag, such as boys frequently amuse themselves with, informed me that the balloon had rent, and at the same time some of the cords—two of them—separated from the concentrating hoop; and that side of the balloon at which this took place, as quickly bulged out, and immediately the atmosphere round the machine got filled with a whitish filmy vapor. This was the consequence of a mixture of warm hydrogen with cold atmosphere. The hydrogen in a balloon is always warmer than the surrounding air, when the sun is shining on its globular surface. The explosion was caused by the neck-pipe being pressed between the concentrating hoop and the lower surface of the balloon, and this pipe being tin and pressing also against two of the net-cords which were brought to an angle by being forced out a little by the muzzle of it, caused them to break at the same time. Although the breaking of two cords next to each other out of the twenty-four—which was the number in this machine—did not seem to endanger my situation much, but seemed rather to have relieved me to some extent from the very precarious condition in which I had been a few moments previously, it still destroyed that mathematical strength existing in its complete state, which made me feel anxious to return to terra-firma. I looked at my watch and found the time to be five minutes past four.

After the explosion of the lower part of the balloon, it commenced a tolerably rapid descent, and as the atmosphere had got considerably clearer than it had been when I started, I could more easily distinguish the face of the country beneath. On observation, I found the balloon was gradually descending on the village of Womelsdorf. Here I received a salute from a volley of musketry, by a company of volunteers who were celebrating the National Republican birth-day at that place. Although I had determined to let the balloon sink to the ground as soon as it possibly would from its own gravitation occasioned by the loss of the gas through the rent, for I had no control of the valve, this salute of firing and shouting inspired me to rise again, and accordingly papers and ballast were thrown overboard, sufficient to send the machine up at least two miles high. No sooner was this height attained, than it again commenced to descend very gradually, which brought me to the earth about four miles west of Reading. Here an incident occurred which was as amusing to me as it was terrifying to the individual who was a party thereto. Being likely to descend in a cluster of trees, I threw out some ballast to cross them—at the same time the grappling hooks took hold in a branch of one of the trees, which was broken off and dragged along. At this moment I perceived a countryman mounting the top rail of a worm-fence about a hundred paces ahead of the balloon, to which point the wind was driving it. I hailed him to assist, for the balloon was floating the length of the grapple rope above and dragging the limb of the tree along below. He looked in every direction but upwards, and in another moment the limb and grapple came square up against the panel of fence upon which he was sitting, and threw it down, pitching the man head foremost into the meadow before him, from which he sprang terror-stricken, if fleetness of foot is any evidence of such feeling, for he was soon out of sight, leaving me to manage the best way I could, which was by being driven up against a woods. Here I got the assistance of two women who had been working in the hay-field, and who promptly came to my assistance when I called them, although they were much excited, having never seen such a contrivance before, as they informed me. Had it not been for these Amazonian ladies, I should inevitably have gotten into the woods, for a brisk gale was just passing over at the time.

Thus ended a voyage, after having been in the atmosphere one and a half hours, full of interest, excitement, and a great deal of instruction. So far were these difficulties from discouraging me, that they, upon the other hand, dictated me to go on and perfect the deficiencies in my apparatus.

In the following August, I made two ascensions with this same balloon from Reading, Pa., neither of which would be calculated in its description, to throw much instruction upon the subject to the learner. The first was cut short from a want of excess of ascending power, making the duration of the flight short in time, and but four or five miles in distance. The second was similar to the first. This balloon, being a very inferior one from the beginning, had now become even worse. Its repairs and its recoating made it very cumbersome, and rendered it impossible to give the satisfaction due the citizens of Reading, for the very liberal encouragement they extended to me on the occasion.

Having realized money enough from these ascensions to build a silk balloon with, in the coming winter, I determined to make the last experiment with the muslin machine on the 1st of October following, from the city of Lancaster. It now weighed over two hundred pounds without the net-work and car, and from this it will be perceived that it required as much gas to raise it with an individual, as would a silk balloon of the same size require to carry two individuals; or, it took as many cubic feet of gas to raise this machine from the ground alone, as it would take to raise a silk one with a passenger. A silk one of the same power weighs from forty-five to sixty pounds. Thus, it will be seen that the expense of inflating this cumbersome machine was almost double that of a silk one, to say nothing of the advantages in easy management, a silk one possesses over a muslin one.

Having announced a public ascension from the city of Lancaster, for the 1st of October, I took the precaution of having an abundant supply of material for generating a large quantity of gas; being desirous that nothing should occur to prevent the occasion from being satisfactory in every respect. But in this I was doomed to disappointment; and a relation of the cause will be useful to those who may become engaged in similar experiments. The day for the ascension turned out to be a fine clear one, with a strong wind from the north-west; and everything connected with the inflation and preparatory arrangements went off in a satisfactory manner, and when the time had arrived for the ascension, the balloon was filled to an extent which gave it an ascensive power of a hundred pounds more than the whole weight it was required to raise, which enabled me to carry a quantity of ballast that would secure me in choosing a place of descent, that might require a dozen of ups and downs during the voyage. Thus provided, everything was got in readiness for a start, and when the machine was released from its moorings it required the strength of four men to hold it from being dragged along by the force of the wind. The arena being on one side of the street, and a range of two story buildings on the other, it was necessary that the balloon should rise with a motion equal in velocity to that of the wind, in order to clear the tops of the buildings. And it was also necessary, in order to accomplish this, that the balloon should be detached at the right moment, for the wind would press the balloon down, so that it would stand at an angle of 45° with the car, and if the car should be released at such a moment it would swing like a pendulum, and before the balloon could attain a sufficient elevation to clear obstructions, it would be dashed against the buildings. All this I was well aware of, and mentioned it to some of the persons to whom I confided the charge of the car when about to start; but, as the sequel will show, they were very near having me "killed with kindness." The chafing, tossing, and plunging gambols of the balloon, when it was only restrained by the holding of the car, soon produced the like, or at least, corresponding actions and emotions in a great portion of the audience and those who had charge of the car, and several times the machine dragged all those who had hold of it half way across the arena, when they as often took it back again to the place from where I desired to start. Seeing now that the excitement increased with the wind, I found the sooner I should start the better, and I struck upon this plan: two strong cords were tied to the basket at a quarter of its circumference apart; each of these cords was six feet long, and held by two men; by these the whole machine was restrained, and the order for starting was this—when I cut the one cord it was the signal to let the other go, as I could not cut them both at one time.

I now watched the moment when the balloon was *rising* in her vibrations caused by the gale, and at that moment cut the cord, but the other two, instead of being punctual in letting go theirs, clung on to it until the machine dragged them along with several more who quickly seized hold of it on seeing its furious career, until they were all brought up against the side of the enclosure next the houses, where they all let go just at the moment when the balloon was most depressed by the gale, and the consequence was, the car was dashed with a tremendous swing against the eaves of a two-story house (I was on my one knee at the time, or

I should most certainly have been pitched to the ground), severing the cords on the side of the basket which struck, letting that side down and *spilling* me out on the very apex of the house, stunned by the concussion.

In a few moments I recovered my senses; my first impressions were like those of awakening from a dream; but, on getting up on my feet over the apex of the house, the shouts of the vast concourse of people below soon woke me into stern reality again. Looking up in a south-easterly direction, I beheld the balloon plunging furiously into a chasm of dense, black clouds, and so ended the experiments with a machine that had given me much more trouble than reputation as a skilful aeronaut.

CHAPTER V.

Abandonment of the old, and construction of a silk balloon—Spontaneous combustion of oiled silk—Strange coincidences—Their causes—Ascent from Lancaster with new balloon—Comments on it—Effects of the sun above the clouds—Experiments on echo—Rising and falling through the cloud stratum—Final descent at night—Balloon moored to Mr. Stump's house—Terrific explosion of balloon—Persons injured by it—Accident to the aeronaut—His return home.

Having now abandoned the muslin balloon as an aerial ship, I procured a lot of silk to build a new one with. But as it is not stated in the previous chapter what became of the old machine, having left her at a point in the clouds, it will be no more than justice to her history to give her final exit. Having risen to such a height in the atmosphere that the dilatation of the gas filled the whole cavity of the balloon, and its ascending power being capable of carrying it up much beyond that point, the expansive power of the gas of course burst it. From the appearance of some green foliage of trees that was in the car when it started, having turned black, it must have attained an immense height in the atmosphere; for having a six inch neck-tube in it which was open when it ascended, it rose to a much greater altitude than that at which it became completely filled by diminution of atmospheric pressure. It descended near Bordentown, a point north of east from Lancaster, about seventy-five miles distant.

During the winter of 1835 and 1836, I constructed a new one of twenty-four feet diameter, and of a pear shape. The silk was of a kind termed India sarcenet; it was white, and in sixty yard pieces. This silk was coated with a varnish composed of linseed oil and gum-elastic (caoutchouc). The gum-elastic was dissolved in spirits of turpentine, which was afterwards boiled up in drying oil. After I had the silk coated twice, and it had become seemingly very dry, the segments or gores for the balloon were cut out in readiness for sewing them together. A dozen of these were cut out, rolled up, and laid on a pile in a dry loft, where they had remained from one morning to the next, during which time spontaneous combustion had so far progressed, that in a few hours more from the time I discovered it, the pile would have been in a blaze, and no doubt, would have set the building on fire. A portion of the gores had already become a putrescent mass emitting heat and smoke, and were rendered useless. This liability has proved fatal to many an aeronaut's balloon, and it is one which I have entirely overcome, as will be seen under that part of this work which will treat upon the construction of balloons.

This machine was finished in the spring of 1836, and was named the "Meteor," and, lest the coincidence of its fate with its name, and that which occurred during its manufacture, should be construed by superstitious reasonings, as it was attempted at the time, it is well enough to state here, that the very circumstance of spontaneous combustion in the silk, suggested the name which the balloon received. The sequel will show that this machine ended its career in a globe of consuming fire. Besides this, two members of my family dreamed that this machine took fire while sailing aloft, and even advised me to abandon its use while finishing it, for some of the silk which was in the damaged lot was used in its construction. Now I looked upon it that these dreams and forebodings were suggested, or rather took their origin from the same cause, as did the name of the balloon; the spontaneous combustion of the silk in question. The smell and smoke that arose from it filled them with alarm and apprehension of fire in connection with balloons, which naturally engendered such dreams.

The "Meteor" being completed, was found upon trial to be very air-tight—an essential quality in a balloon. The citizens of Lancaster, desirous of having an aerial experiment on a most liberal scale, contributed an amount of money so as to have the ascension free, from the common. Accordingly, an invitation was extended to the people of the county, to witness the spectacle on the 7th day of May, 1836.

Everything for the occasion being got in readiness, the day arrived. I will now quote from the newspapers of the day the account of the operations as far as stated by them, considering them impartial historians of facts that transpired under their conductors' eyes. "On the afternoon of Saturday last, a most brilliant balloon ascension was achieved by our townsman, Mr. J. Wise, from the common near the head of West Orange and Chestnut streets. The circumstances under which this truly splendid ascension was accomplished, entitle it to honorable mention and particular commendation.

"The day was extremely disagreeable; a succession of showers, ushered in by the morning's dawn, and continuing with intervals of most undesirable *brevity*, left but little reason to induce the belief that an attempt would be hazarded—much less that, if made, it would be successful. Occasional glimpses of sunshine only served, like hope deferred, to make the heart sick; for they were invariably and rapidly succeeded by pelting rains. Notwithstanding all these apparently insurmountable obstacles, Mr. Wise persisted in his determination to attempt an ascension; and at the meridian hour his intentions having been announced to the public, and spread like wildfire through the city, the crowd began to assemble. By three o'clock the ground was pressed by the feet of many thousands; and amid the war of the elements, the process of inflation was commenced. From the state of the atmosphere this necessarily proceeded but slowly; but the impatience of the vast assemblage was properly restrained, and their curiosity gratified from time to time, by the letting off of a number of small *untenanted* balloons—one of them of most fantastic shape (Flying Dutchman), and whose aerial gambols were productive of infinite diversion.

"Soon after five o'clock, the rain having ceased, and the balloon being properly inflated, the intrepid adventurer calmly took possession of the frail vehicle prepared for his reception; the glittering ball rose slowly and majestically above the ocean of heads; the cords which bound it to the earth were severed; and, amid the waving of hands, and the shouts of the multitude, winged its way to the regions above.

"As it rose, Mr. Wise was discovered standing very composedly in his little car, and acknowledging the salutations which accompanied his departure. The balloon rose steadily upward for a few minutes, then shaped its course in a direction nearly south of east (in nautical phrase), and, in something less than a quarter of an hour, slowly entered the yawning chasm of a huge black cloud, at an immense height, and apparently hovering over a surface of the earth many miles distant from the starting point. After this, the good people of Lancaster beheld him no more.

"Mr. Wise has not yet been heard from; nor can it be satisfactorily ascertained that he has been even *heard of*. As might be expected, rumors are rife; serious apprehensions are entertained for his safety, as his course was nearly direct for the Chesapeake; but we hope for the best, and trust that next week, we shall have the pleasing intelligence to announce that he has returned to the warm welcome of his many friends.

"Since the above was in type, we have received the Philadelphia Public Ledger of yesterday, which says that Mr. Wise arrived in that city on Tuesday. At half-past eight o'clock in the evening of Saturday last, he let off the gas, and descended near Port Deposite (Md.). The anxiety manifested by the citizens to give him assistance, placed the lights brought by them in contact with the escaping gas, which immediately exploded, causing the entire destruction of his splendid balloon, instruments, clothes, &c., and so severely burnt and injured Mr. Wise, that he is now confined to his room in Philadelphia."

The following is an extract from another of the Lancaster papers, concerning this ascension: "The balloon ascension on Saturday last, unfavorable as were the circumstances under which it was accomplished, was one of the best we have ever seen. The heavens were overhung with clouds from 'morn till dewy eve;' there was a continued succession of drizzling showers during the whole day, and the air was so saturated with moisture, and (apparently) so 'heavy,' that there were few, we imagine, who did not feel strong doubts of the ability of the aeronaut to accomplish his object. The interest excited in behalf of Mr. Wise, however, was deep and general. He was surrounded, during the whole process of inflation, with a friendly and sympathizing crowd, among whom were many of our most respectable citizens. The hostility of the elements, and the gloom of the day were, in a measure, counteracted (to the aeronaut) by the kind assistance of some, by the good feeling and forbearance of all.

"The atmosphere being really *lighter*, and less favorable to the evolution of gas than in clear weather, and a greater quantity of hydrogen being required, for the same reason the inflation of the balloon necessarily required a longer time than was anticipated. It was, therefore, half past five before the process was completed. Without further loss of time, and with the coolness and self-possession of a veteran in his dangerous vocation, Mr. Wise stepped firmly into his car, quickly adjusted and regulated his ballast and appliances, cut the cord, and was rapidly borne upward, amid the loud 'god speeds,' of an immense and gratified assemblage. The course of the balloon was directly south, the aeronaut standing up and waving his hat as long as he continued in sight. His 'vessel,' however, soon plunged into the clouds and disappeared. Above, we have no doubt, a kinder sky, and a bright and genial sun threw light and warmth over his aerial path, and compensated him, by the splendors with which he was suddenly surrounded, for the gloom which attended his departure.

"P. S.—No certain tidings have yet been received of the aeronaut. Rumor has landed him near Belle Air, Maryland, about forty miles distant, but such does not appear to be the fact."

Having now given the disinterested testimony of the journals of the day, of this experiment, as far as their immediate observation enabled them to do so, leaving me as it were entering into a world, which was divided from the one I left, nine minutes before, by a thick barrier of clouds, the balance will be related from the notes kept by the way.

In about two minutes after I entered the cloud stratum, the balloon emerged from the top. Just as it was penetrating the upper surface of the stratum, I found the cloudy vapor quite warm, and immediately, on emerging from it, this warmth was increased to a degree of temperature above that of comfortable feeling. A pungently stinging sensation was also produced upon those parts of my persón which were exposed to the sun's rays. This I attributed to the hydrogen, which was let off while passing through the clouds, some of which hung to me in passing through it. Having started with considerable ascensive power, and having nearly one hundred pounds of ballast in the car, a considerable quantity of gas was discharged while passing through the clouds, which was intended to counteract, in a measure, the *increased* ascending velocity the balloon would attain, as soon as she would get under the direct influence of the sun's rays, above the stratum. Notwithstanding this precaution, as soon as the barrier was passed, the balloon, in a few moments after, sped up at a furious rate, until it reached a height at which the barometer stood at nineteen inches, and the clouds appeared at an immense depth below me. Not experiencing much warmth by the reflection of heat from the clouds at this distance above them, and the balloon, now moving in an angular direction to that of the clouds, their upper surface lit up in a brilliant white light, gave it the appearance of a vast circular ocean of snow, rolling along in a wave-like motion, in the most majestic grandeur, and the cold frosty state of the atmosphere, from which it was beheld, rendered this *snow scene* most impressive.

I next discharged gas until the barometer stood at twenty-three inches. At this height, it being but a short distance above the cloud surface, I found the temperature very congenial, and continued the rest of the voyage, varying by barometer from twenty-three to twenty-two inches. In the rise and fall of the balloon above the clouds which occupied twenty minutes, it described a spiral circle; and, on coming near to the surface of the clouds, I recognized a familiar tune of martial music, which I afterwards learned was the very tune played by the musicians of the city battalion of volunteers, who on this occasion formed a cordon around the ascension ground, they being invited to attend and participate in the enjoyment of the spectacle. An opening in the clouds which occurred for a moment, also developed to me a watercourse below, which I took for the Conestogo. My course now lay, as near as I could judge, towards the south; but in order to be more certain concerning my whereabouts and direction, discharged gas and darted down through the clouds; but when below them, the country appeared so rough with forest hills, and the space between the hills and the lower cloud surface so shallow, I quickly threw out some ballast which sent me up again partly into the clouds. Hearing a cowbell and the sounds of a wood-chopper's axe, I hailed in the following manner: "Halloo," to which I heard the reply, "Halloo." I next inquired, "How far is this from Lancaster?" which in a few moments was returned by "*How far is this from Lancaster?*" Believing this to come in response as an inquiry to know whether I wished to learn that fact, "the distance to Lancaster," I repeated it again in very measured accent. This was again responded to in like measured accent, apparently to my mind as an intent of mockery. Being in the clouds, and not able to see things either above or below, I felt somewhat nettled at such clownish display of wit, and in a very audible tone of voice, while the foregoing was still reverberating on my ear, sung out, "Your are a fool," which in a very few seconds was answered in an equally distinct and measured tone of, "You are a fool," when it suddenly flashed upon my mind that it was the echo of my own voice, which opinion was ratified by the dying reverberations of "you are a fool," which had now become as numerous as though a whole regiment had caught the watchword and were passing it in quick succession through the whole line. Involuntarily I exclaimed to myself, "Fooled, sure enough." Being determined to find out my whereabouts, I let off sufficient gas to get below the clouds, when I observed through a spy-glass a little clearing in which was a cottage, and before it a man. His face was turned upwards, apparently drawn in that direction by the dialogue I had with myself, and which no doubt he had heard. I inquired of him whether he saw me, for I was then standing up in the car and waving a flag to draw his attention. He answered, "Yes; who are you?" I replied, "An angel of light." Upon which he cried out, "Is your name Wise?" To this I responded, "Yes; how far is this from Lancaster?" to which he answered, "Sixteen miles," upon which I bid him "good by," threw out some ballast, and went up through the clouds again. As I was passing up I heard him say, "God bless you, man."

Having now become interested in this singular phenomenon of echo, I continued making experiments in it. I found when sailing some hundred feet above the cloud stratum, that the echoing sound was short, not near so sonorous or musical to the ear as when in the clouds or immediately beneath them. Still I could hear the reverberations until they became blended into mere undulatory sounds. When at a considerable elevation above the clouds, one or two thousand feet, I could discern no echo, and the report of a rifle was short and sharp; so also the sound of a bell, and the chopping of an axe. From these experiments, I think one loud clap of thunder, occurring when a dense stratum of clouds is extended over a great portion of surface, is sufficient to cause that long continued rumbling thunder which we often hear, one echo inducing another, until by multiplication they become so numerous as to blend into a mere rumbling vibration in which it is neutralized and lost, as are the waves which are caused by throwing a stone into water.

The wind just above the cloud region appeared to be vibrating from various points of the compass, causing the balloon to describe a kind of zig-zag course in a southerly direction, necessarily making the progress in that direction somewhat slow for aerial traveling.

Knowing my course would carry me on to the bay shore, and having been aloft nearly two hours, it was evident that I must be nearing the Chesapeake unless the balloon was making a different course from that of her first sixteen miles. Consequently another gradual descent through the cloud stratum, which was still very dense, was made, which brought the machine over Conewingo Falls in the Susquehanna River. The roaring noise as it met my ears, while yet in the clouds, gave me some foreboding that I had reached the bay shore, taking the noise of the falls for that of the bay surf. My anxiety was relieved from this, and increased in another quarter; for, in coming through the clouds, the falls were immediately underneath me, the balloon descending very rapidly, and the opposite side of the river lined with highlands and trees, and it was not until a great quantity of ballast was discharged that the balloon overcame the obstacles. I hailed some individuals living at the falls, who invited me to descend and partake of their hospitality, which, however, the position I was placed in compelled me to decline. Before I made this reconnoissance, the sun was near the horizon above the clouds, and when my vessel got below them I found the earth shrouded in a gloomy twilight. The Chesapeake lay some miles to the south, and the direction the balloon was making would carry it along its western border. The large quantity of ballast discharged in crossing the falls, caused the balloon to rise to a great height above the clouds, bringing, as it were, the sun above the horizon also, which but a few minutes before was sinking behind a bank of clouds, and had now become elevated twelve to fifteen degrees. This phenomenon interested me more than it deceived me, but was still the cause of keeping me aloft until it had got dark below, which circumstance cost me my balloon and a most terrific accident.

Seeing now, at even that height, that the day god was fast sinking in the cloud horizon, I commenced a gradual descent, and before I reached the upper-surface of the clouds the sun was lost behind their western bound. The descent through this vaulted ceiling of the earth was dark and gloomy in the extreme. A deathly silence, equaled only by the impenetrable darkness that surrounded me on all sides, made the descent awful, and yet grand and imposing. As soon as the clouds were cleared, a few scattered lights were visible, which apprised me that I was coming on land, and in a few moments after I felt my drag-rope, which was four hundred feet long, glide gently over tree tops, and in a few moments more I felt, by its motion, that it was dragging apparently over smooth ground, and hearing at the same time human voices not far off. The grapple-iron was immediately thrown out, which as quickly brought up the vessel near a fence. Having hallooed considerably while descending from the clouds to the earth, and hearing no response, I next betook myself to loading my car with stones which were within my reach. Having accomplished this in a manner sufficient to keep the balloon anchored by the car in case the grapple-iron should slip its hold, I commenced hallooing again, which was immediately answered by a colored man, as I judged from his dialect. He cried, "Where are you?" I answered, "Here, with a balloon." He replied, "I know dat." This surprised me, and I cried out, "How do you know it?" He answered, "I smell de balloon." This surprised me still more, but he having in the meantime come up to me, informed me, upon inquiry, that he had helped to fill a balloon at Baltimore the fall previous, and that as soon as I told him I was there with a balloon, he concluded I had come from Baltimore with one, having no doubt of what I told him, because he smelled the hydrogen. Uneducated man as he was, I found him one of remarkably quick perceptive faculties, and just such an one as an aeronaut is glad to meet with on his descent. He informed me that I had landed between Belle-Air and Port Deposite, on the plantation of Mr. Stump, in Harford county, Md. By his assistance the balloon was moored near the house of Mr. Stump, when we roused the family, they having retired to bed at an early hour. Here we found plenty of assistance, Mr. Stump giving me a very cordial reception, at the same time ordering his colored men to render me all the assistance necessary. As it was drizzling, and the grass was wet, I determined to discharge the gas from the upper valve of the balloon, and thus be enabled to fold the whole machine into the car beneath it, as it gradually collapsed. This process being necessarily slow, and the atmosphere very humid, it became impregnated with the hydrogen for some distance around the balloon. Being some distance from the house, and having a lantern standing at least fifty feet from the balloon, I apprehended no danger from the escaping gas. Things went on in this way until the balloon was emptied to within a thousand cubic feet of gas, her upper end being now drawn down and one of the men with his hand pressing open the upper valve, while I was standing at the other end carefully folding the loose silk into the car. While thus engaged, Mr. Stump standing about thirty feet behind me, and some half dozen more persons near and round the machine, either the lantern, or some other light which had in the meantime been brought to the scene, ignited the explosive mixed atmosphere that was hovering around the balloon, making a report like a park of artillery, throwing me violently back at least ten feet from the place I was standing, setting fire to the clothes of some, and severely scorching the faces and hands of others, and even Mr. Stump did not entirely escape the effects of it, although a considerable distance from the machine.

I quickly sprang upon my feet again, and jumped on to the remainder of the balloon which was burning in the car, and which was thus extinguished by tramping it out—the gas that had by the sudden explosion been liberated from the balloon, in the mean time rose rapidly into the air "like a consuming fire," with a rushing noise, until, at a considerable height, it was totally consumed like a dying meteor.

There I stood in deep reverie, scarcely able to realize the events of the last few hours, with feelings like a person awakening from a dream, in which all the magnificence—sublimity—solemnity—terror—consciousness of approaching death, that the human mind is capable of conceiving, agitating my thoughts. For, at the moment of the explosion, the death pang flitted through my mind. In a few moments I was aroused from my fixed position by an agonizing pain through my whole body, which soon concentrated itself in my hands and face. I felt as though the very heart's blood was oozing through the skin, and I was soon made sensible that I was wofully scorched in those parts—the watery fluid of the system was oozing out in profuse drops, and some of the poor negroes had fared no better than myself in this respect, which their agonizing screams too plainly told. Mr. Stump, who was more of a spectator than an immediate sufferer in this terrific affair, being a very considerate gentleman of advanced years, came up to me and desired me to accompany him to the dwelling, for, by this time I had become almost totally blind, and moreover began to feel very sick from the excruciating pain caused by the burns. It also pained me that I had been the cause of Mr. Stump's men being burned, but he, on learning this, begged me not to trouble my mind about that. He also extended me all the care and comfort my condition required, and the following morning, at my earnest request, I was furnished with a vehicle to take me to Port Deposite. Here I had my burns dressed, and on the following Tuesday morning left for Philadelphia, much against the advice of the physician who attended to me at Port Deposite, and reached Philadelphia on Tuesday evening, where my family resided at the time, with my hands and face very much swollen and inflamed. By dint of blood-letting, wholesome diet, and the constant application of cooling cataplasms, I was out in ten days afterwards with a new skin on my hands and face, determined to make a new balloon, feeling satisfied in my own mind, that all my sufferings were overpaid by the learning I had received in the adventure.

On my arrival in Lancaster, I met with a most honorable and hospitable reception, as well as with the means, supplied me by a voluntary contribution of the citizens, to procure a new balloon. Thus ended an experiment which had taken me through an ordeal that was well calculated to make impressions on my mind that will never be erased while living, and to which I invariably recur with the most vivid sensations of satisfaction, painful as were *some* of the exciting incidents connected with it.

CHAPTER VI.

Promptings of the author's profession—Spirit of development—Construction of a new balloon—Its failure—Abandonment of the art for a year—Mr. Cocking's fatal experiment—Report of it in the United States—Causes the author to make another ascent—Account of same—Balloon inflated with coal gas—Newspaper extracts of the occasion—Particulars of the experiment—Successful termination.

Having now completely recovered from the accident that had befell me in the last experiment, and feeling as though I had been fully initiated into a most fascinating art, I firmly resolved to make it my future profession. The scanty knowledge that was in existence at the time, leaving the few persons who were engaged in the art to grope their way through an unexplored region without a guide—even without well-directed theoretical instructions—

also had a tendency to bring me to such a resolution. How could it be otherwise to an observing and investigating mind? A vast field of science lay open to the investigation of man! It required him but to lay his hand upon the lever of the atmosphere, and elevate himself into and above the region of clouds, where a new life—a new spirit—a new world of science and art developed itself to his searching imagination! Geography, topography, natural philosophy, atmospheric phenomena, meteorology, astronomy, all assume a new feature. The ability to explore the surface of the bottom of the ocean would no doubt be a grand privilege. The ability to make a supra-mundane voyage—to sail above and below the cloud-vaulted canopy of the sky—to glide through nature's rain and snow-making laboratory while in full tide of operation—lit up with electric lights—the facility of soaring above these scenes, while the harmless thunder *rattles* beneath you, and the zig-zag coruscations of electricity look like sparkling diamonds shooting athwart snow banks—your vessel all the while moving with a smooth, apparently motionless, but grand and majestic pace—twenty, forty, and not unfrequently eighty miles per hour, is even a greater privilege. But it is not yet properly—nay, it has not yet begun, to be appreciated; the human family has not yet been initiated in this grand prerogative. The day of steam-power transition must attain its acme; then the new-born art will be seized upon and be made to run a career that will leave railroad and steamboat transition as far in the background, as they have left the stage coach and horse boat.

This epoch is fast approaching. The ultimatum of steam transition is approximating; the introduction of a more facile mode is becoming the theme of the age, the pole star of genius; the present century will enjoy its great advantages—its world's civilizing effects. Such is the spirit of this unexplored subject. With such a field in view, it was a sufficient apology—a sufficient stimulant, for even an humble searcher in progressive science and art to take upon himself a voluntary pioneership in the exploration of a new and promising estate which has been opened to the human family.

Had I been content with the mere knowledge of constructing a machine by which we can attain an elevation and flight in the atmosphere, my labor on the subject would have ceased with the knowledge I had now acquired. But there it did not, could not rest. That simple part of it wanted improvement. A balloon capable of remaining in the atmosphere three or four hours was but an imperfect machine, compared to what it ought to be, in order to make experiments that would give the subject a consideration worthy of its magnitude. I might have gone on well enough in merely making balloons and balloon ascensions as a matter of novelty and amusement, but the mind in its progressive spirit yearned for a more extended and useful application of the art. And yet to undertake this in a professional way, depending upon public forbearance while prosecuting the subject under public patronage as a source of amusement for them, had before it many difficulties. A failure in what should be announced as a public exhibition was almost a certain signal for the demolition of the unfortunate aeronaut's property, with no small degree of condemnation on his head as an impostor. And yet, under these foreboding auspices, I launched out into the world with the new business, determined to experiment in the way of improvement as I went along, let the consequences be what they might; and, although this determination frequently brought me into most embarrassing predicaments—often into feelings of intense chagrin—still, through an experience of fifteen years in this profession, I never met with any attempt to violate my property or person, but, on the other hand, with encouragement and praise when I succeeded; with sympathy, kindness, and forbearance, when I failed. This obligates me to give to my countrymen and the world, all the knowledge I have acquired in the practice of the art.

As the last used balloon had been coated with a solution of gum elastic, which had made it very impermeable to the hydrogen, I determined to coat the next one with the same substance, prepared in a different manner. I dissolved the gum by heat alone, not knowing at the time that under such a process it loses all its elastic property, which it never regains after being melted. It even loses its elasticity to a great extent when dissolved in spirits of turpentine. And thus far, there is but one solvent for it known, under which it resumes its elastic property when used as a varnish, which will be treated on under the head of balloon construction in this work.

Accordingly, I finished a twenty-five feet diameter balloon, coated with this new kind of varnish, which seemingly promised to answer a very good purpose, although on completion it showed a want of elasticity, such as is necessary to overcome the effect of folding up the machine. She was named the "Experiment," and an unfortunate experiment she proved to be. When folded up and packed away for a few days it acquired heat (affinity for oxygen) until it became a putrescent mass. From this I attempted to restore it by the application of drying oils, and under this, as well as other ineffectual applications, I failed three successive times in getting it sufficiently inflated to carry out the object announced—a balloon ascension. These experiments were made in Lebanon and Dauphin Counties, Pa., and served to make me pecuniarily bankrupt in the business, and almost so in reputation as an aeronaut. The third trial I let the balloon off by itself, determined to get rid of so unprofitable a machine.

I now returned to Philadelphia, and got employment at philosophical instrument making, which afforded me a pleasure, as well as a gradual acquirement of means with which to resume the balloon business again. While thus engaged, a good opportunity was afforded me of studying and practicing in the science of electricity—a subject that mingles with the minutest details of all human operations. The profession of ballooning had given me an uncontrollable desire to study such subjects. These things, in the meantime, were preparing me better than I had been before, to engage in my favorite avocation again, as soon as opportunity should offer.

While thus engaged, and during the latter part of the summer of 1837, the London newspapers brought us over an account of a most melancholy accident which had befallen Mr. Cocking, an aged and scientific gentleman of the city of London, while attempting a descent with a newly invented parachute. The old plan or form of the parachute being concave, or rather hemispherical, made it liable to violent oscillations while descending through the air, being considered very objectionable and unpleasant. Mr. Cocking proposed to construct one which should not be liable to such action, but should descend with a uniform and steady motion. This was to descend on the principle of cleaving or *wedging* through the air, instead of, as in the old plan, *compressing* the atmosphere. Its form was that of an inverted cone, or we might say funnel-shaped. The upper part, or large opening of it, was forty feet in diameter; the lower opening was four feet in diameter. It had hoops in the upper and lower openings to keep it distended. Around the lower hoop the cords were attached, to which the car or basket containing the aeronaut, was fastened. The lower orifice also served to let a column of air pass through which would act the part of a centre pole—rushing through it from bottom to top, and steadying it in its descent. The upper hoop was composed of two inch tin tubing, the lower one of wood.

With this machine attached to Mr. Green's large balloon, he ascended, in company with Mr. Green and another person, from the city of London, to an altitude of about 8000 feet. This parachute was fastened to the bottom of the car in which Mr. Green and his partner were stationed, and was so contrived that Mr. Cocking could detach it without the assistance of those in the balloon car.

According to the account given, Mr. Cocking betrayed considerable excitement while ascending, as related by Mr. Green. When at the altitude above mentioned, he requested Mr. Green to detach the parachute, but the veteran aeronaut not having sufficient confidence in the structure of the new invention, refused to do so, and desired Mr. Cocking to do it himself if he was determined to try the experiment, of the successful result of which Mr. Green expressed some doubts. Upon this, Mr. Cocking gave notice that he would detach himself, which he instantly did. The parachute did not fall far before the upper hoop *kinked* and finally broke, causing the parachute to collapse. The unfortunate experiment resulted in death. The balloon, when released from this weight, sped upwards at a furious rate, the aeronauts with it betaking themselves to some air-bags carried along for the emergency, from which to inhale pure air while passing through the escaping hydrogen that was now being let off as fast as possible, to overcome the balloon's rapid ascending motion.

The account of this catastrophe was severely commented upon, both by the foreign and American newspapers, almost universally condemned by them as a fool-hardy attempt, with no possible chance of success in its trial or practice. And, although Mr. Cocking was represented as a man of no inconsiderable scientific attainments, still, he was denounced as being supremely visionary and unscientific in this particular instance.

Looking at this contrivance of Mr. Cocking's with an unprejudiced eye, it struck me as remarkably ingenious, embracing none but true principles, adaptive to the end for which it was intended; and so confirmed was I in this conclusion (and am yet), that I would not have hesitated to repeat the experiment with a similar machine, with no other alteration than a tough wooden hoop in the top of it instead of a tin one as was in his machine. I ventured this opinion in a Philadelphia newspaper at the time, and promised to demonstrate its truth before the summer should pass by, by experiment with a true model of this new invention in leaving down, from a great height, a living animal.

Having a short time before this received a letter from Mr. Geo. Diehl, of Lebanon county, informing me that he had recovered the balloon "Experiment," which I had the summer before sent adrift as good for nothing, and which, he told me, was at my service if I wanted it. I at once determined to send for it and endeavor to repair and enlarge it, so that it might answer for a single ascension by being inflated with carburetted hydrogen gas, which was now being extensively manufactured by the Philadelphia "City Gas-works." Accordingly, this machine was procured, but it was in a very damaged and mellow condition; it had, however, lost much of its adhesiveness. With this I determined to make the experiment. To make it large enough to carry the required weight when filled with coal gas, it had to be enlarged so as to hold several thousand cubic feet more than was its present capacity. This was done by cutting it apart at its equator and inserting a belt, which was soon accomplished by merely pasting in the band by the adhesiveness of the old varnish, lapping the edges about one inch and pressing them together with a warm sad-iron. The belt was composed of black silk, varnished with bird-lime varnish, which was all very good; but the old part of the balloon was so mellow as to be scarcely able to bear its own weight when lifted up by any part of it. However, I knew that if it would bear the test of inflation, it would have less force to bear when freed in the air with its burden. This is a mathematical principle in ballooning that very few people believe in, and much less willing to *test* its truth.

Thus provided, an announcement was made to the Philadelphia public, that a balloon ascension would be made from the corner of Filbert and Broad streets, with a balloon inflated with carburetted hydrogen, on Monday morning at 10 o'clock, September 18th, 1837, in which I would show that Mr. Cocking's plan of a parachute embraced the true principles of safe and pleasant descent from great altitudes, which would on this occasion be shown, in comparison with the old fashioned parachute with which living animals should be let down from the height of a mile, and which should land on the earth in perfect safety.

Before giving my own description of this experiment, an extract from one of the newspapers of the day will be given.

THE BALLOON ASCENSION AND DESCENSION.

"The ascension of Mr. Wise of yesterday, was truly an imposing and pleasing sight; and from the unbounded applause that greeted the intrepid aeronaut, both in and out of the enclosure, we should suppose that the gratification of Mr. Wise and his auditory was mutual. At about half past eight o'clock, the hum and bustle of the various pedestrians that were wending their way westward, bespoke the citizens alive to the amusement of the morn; and at about half past nine the streets, trees, fences, and tops of houses in the vicinity of the arena were completely studded with men, women, and children, and naughty boys. About ten o'clock Mr. Wise prepared to depart; the aerostadt was harnessed to the car, and all the paraphernalia for the perilous voyage properly arranged. Poor Tabby and Tray were by no means disposed to become encaged without some show of resistance, and our canine friend, especially, seemed to dispute for his liberty with a growl; pussy, by her looks and gestures seemed fully aware of the *cat*(astrophe) that awaited her feline dignity, but *nolens volens*, was forced to submit. At length the cords were cut, and the pilgrim of the air gave us his adieu, amid hearty cheers. The balloon ascended in nearly a perpendicular line with the yard, and then gently glided to the east; when he attained a height of about two thousand feet, poor Tray was *curtailed* of *higher* honors, and was made to descend to a level with his fellow animals of this lower sphere. He descended in the parachute of Mr. Wise's construction, which seemed to oscillate rapidly to and fro; he descended, however, we believe, in perfect plight. Now came poor Tabitha's turn, in imitation of the unfortunate Cocking; she, however, escaped his melancholy fate, and seemed to descend in a more *regular and steady position* than her canine companion. We believe the plan of Mr. Cocking to be more free from oscillation than the common one; both, however, we believe to be a presumptuous and hazardous experiment, without any beneficial results. We gazed upon the balloon until it was lost to our sight."

The above humorously written account is a fair sketch of what it relates. As regards the parachutes, which were both exhibited in the arena with their occupants, many comments were passed upon their respective capacities of resistance to the air in falling through it, and the Cocking parachute was almost universally condemned; a few scientific persons only agreeing that it would answer the purpose for which it was designed. And I would here remind the reader, that, although public opinion is generally correct upon matters of common import, it is not always so upon matters peculiarly scientific. In this case, the public mind seemed mainly influenced by the accident which had befallen the unfortunate inventor of the machine; had the accident happened with the old-fashioned concave parachute, and the newly invented one now brought in competition with it, the latter no doubt would have received the most confidence, as regarded safety and utility. This dread of consequences and accidents sometimes influences the minds of scientific men, upon new experiments, as was the case in my first announcement of exploding the balloon at great heights, letting the gas rush out instantly, and depending upon the friction of the balloon through the atmosphere for a safe descent. The sequel, however, in both the cases just mentioned, proved that science was correct, and public opinion wrong.

The day of the 18th of September was clear and calm, and well for me it was so, for the old machine was extremely mellow, and would not have stood much of a blast. When the inflation had been nearly completed, a stone which had been thrown at one of the small pioneer balloons by a lad, fell against the large balloon, and cut a hole of about seven inches length through it. This, with much difficulty, was repaired by pulling the machine to one side so as to reach the spot from the top of a cask, and putting over the hole, by slipping under the net-work, a piece of oiled silk coated with adhesive varnish. This accomplished, I started off, ascending perpendicularly to the height of over half a mile.

When but a few hundred yards east of this point, the concave parachute was dropped, which, in two seconds afterwards commenced to oscillate with great violence, to which the dog, its occupant, gave the most ample testimony, by a yelp corresponding to each vibration, as far as I could hear him. Seeing it safely in the hands of some individuals below, the Cocking parachute was next put to the test. I made particular preparations to watch its whole descent, with a spy-glass for the occasion. When it was dropped it oscillated a little for a few moments, and then commenced describing spiral circles of perhaps a hundred feet diameter (this is a mere guess calculation however), the parachute all the while revolving on its own vertical axis, which motion was in the same direction as its spiral motion, and thus it continued gyrating with a double motion, but apparently very smoothly and gracefully, until it reached the top of a dwelling in Eleventh street, where it lodged safely, and was taken in from the dormant window.

Upon the release of these parachutes, the balloon commenced a rapid ascending motion, which, together with the expansion of its gas, and the friction of the net-work, by some means displaced the patch from the rent the balloon had received while being inflated, which soon caused it to gravitate as fast, as it had but a few moments before inclined to an opposite direction. Being at this time at a point over Green street near the Delaware, and the balloon going north-east, it was inevitable that it must descend in the river. Determined, if possible, to cross it and reach the Jersey shore, I threw everything disposable—sand, ropes, grapples, newspapers, instruments, hat, coat, boots—overboard, in order to check the rapid descent of the balloon. But it was scarcely checked before it commenced sinking again, even more rapidly than before. Although it had reached a point near midway the Delaware, the under current of the air drove it near the shore, and almost in contact with some shipping lying at Coates street wharf, from which it was immediately rescued by persons who had assembled to witness its descent. Thus ended an experiment which fully vindicated the *scientific* character of an individual who had been much condemned for his temerity in an experiment that proved fatal to him, from the cause of a mechanical defect in his machine (the upper hoop being tin, instead of *tough* wood). Even with this defect in the upper hoop, causing his parachute to collapse, he would have descended without very serious consequences, by the friction of this vast surface through the atmosphere in a collapsed state, had he not lost his presence of mind, which caused him to receive the shock all at once.

I will not forget to mention that on this occasion sixteen hundred pay auditors honored me with their presence inside the arena, notwithstanding the ascension was made in the morning, a part of the day which many thought would be unpropitious to a pecuniary success of the experiment.

CHAPTER VII.

Construction of a new balloon—First experiment with it—Had to be sewed—Incident showing how balloon could easily be filled with air—Second experiment with it—Made privately—Philosophical experiments for Professors J. K. Mitchell and Espy—Indian Chiefs present—Keokuk's scrutiny of the affair—Black Hawk's remarks—Newspaper notices of it—Account of the voyage—Transparent appearance of Delaware River when viewed from balloon—Encounter of whirlwind—Nearly descending in the fiery pines of Jersey—Final descent.

Having succeeded so well in the last experiment, and that, too, with a machine once before totally condemned, and now enlarged by the insertion of a belt, without a stitch of sewing in it, and the whole affair ending in the most satisfactory manner to the public, as well as with a replenishment of funds sufficient to enable me once more to engage in my favorite avocation, I now determined to build an entirely new machine. The white India sarcenet silk was again used in the construction of this machine, and this time the varnish was composed of a composition of India rubber (caoutchouc), well boiled drying linseed oil, and bird-lime. This varnish dried very well in the sun, in about two days for each coating, of which the silk got three before it was cut in gores to shape the balloon with. This silk, thus prepared, when its edges were overlapped, and then pressed together with a hot iron, seemingly cemented in a very solid manner. As the belt in the balloon I had just used, was cemented in this way, and answered the purpose so well, the whole new machine was cemented together by the same process. When it was completed and tested, as to its impermeability to common air, it proved to be the most air-tight machine of any I had yet made.

With this, I proposed an ascension from the same place where the former one had been made from, also to take place in the forenoon, and inflated with carburetted hydrogen, or, as it is commonly called, coal gas.

The day turned out to be a cloudy one, with slight sprinkles of rain, and by the time the balloon was nearly filled, being about one hour before the time announced for the ascension, it was discovered to have an opening near its top, of several inches in length, which, upon close examination, turned out to be an opening of one of the cemented seams. Seeing there was no time to be lost, and as it was impossible to make any successful repairs to it at the time, I concluded to make a short trip with it out of town, and at least save the credit of having made the ascension, brief as it might be. Accordingly, the car was hitched to it, and off I started, but with all I could do, throwing out all the ballast, the first few squares of its flight, it attained but an inconsiderable height, for the opening in the seam increased, upon its ascent, and the machine came down very suddenly, in Chestnut street near Schuylkill Seventh street, dashing the car against the third story of a house, while the balloon swung over its top, bringing the cords of the rigging to an angle over the eve of the building, keeping the whole machine in that position for some time.

An immense crowd of people soon assembled around the place, where the balloon was thus stationed, for it was only three squares from the place it first started. As a great tumult was going on below, and as I had not exactly accomplished what was designed in the announcement, I beckoned to the crowd below to be heard, which was immediately granted by a momentary silence, when I asked them what they wished me to do. To this I got a thousand or more replies, all tending to the same end, of saving myself and the balloon, by all their various plans and suggestions. By this time, a gentleman in the house came to the window and offered me his assistance. Upon this, I fastened a rope to the car, and threw the other end down in the crowd, requesting them to take charge of the balloon, while I would get into the third story window of the house, which was accordingly done. When I got down, this immense crowd showed the most manly regard to me and my property; the balloon was towed back to the arena with care and order, where it was emptied of the gas, and carefully folded and sent to my dwelling. These kindnesses made me feel more chagrined at the discomfiture of this experiment, than if violent demonstrations had been exercised towards me for my non-fulfilment of the announcement, which was almost universally the case towards my unfortunate predecessors in this vocation.

I determined now, that hereafter, my experiments should be more in a way that would at least insure a greater certainty of success in the mere novel part of the business, that of making a handsome ascension.

This balloon was immediately put under the needle, and a substantial seam put through each joining. While this part of the work was going on, an incident occurred, from the effect of one of the lady's fans, who were sewing at the balloon, which led to a discovery of inflating these machines with common air, that did away with the tedious and troublesome method, heretofore practiced by American aeronauts, of filling with a large pair of bellows. It was simply this: By holding open the neck of the balloon, and fanning into it, with a common feather or palm-leaf fan, the machine could be filled in less time than an hour, while the old method took a day, to say nothing of the trouble it took to rig up a smith's bellows.

Now, although this method of cementing the seams did not answer the purpose in this case, it is not wholly to be condemned. There may be a cement made to answer the joining of the seams without sewing them, though both these principles combined make the surest and best finish.

After this balloon had been overhauled by a thorough repair and improvement, she promised to do more service than any I had yet made. It so happening that about this time several important Indian delegations were in Philadelphia; it was proposed by Mr. John Cash, and several other gentlemen of the city, particular friends to the progress of the art, that a private ascension be got up, and that these Indians, as also a company of "Florida Volunteers," be invited to attend the experiment. The whole expense was defrayed by the first named persons, and I cheerfully volunteered my services and the balloon. Professor J. K. Mitchell also took an assisting and scientific interest in the experiment, and provided me with several air-bottles, made expressly for such purpose; and I was further provided with a "wet-bulb" and common thermometer to make some experiments with for Professor Espy.

In October, 1837, every arrangement being completed, the Indians, with the celebrated chiefs, Black Hawk and Keokuk, the Prophet, and Black Hawk's son at their head, and the Florida soldiers, together with a numerous company of invited guests, being assembled for the occasion, at a few minutes after one o'clock, preparations for a start were made. Just at this moment the chief Keokuk, with the characteristic sagacity of the red man, requested me, through his interpreter, to allow him to make an examination of the whole machinery and apparatus. To this I cheerfully assented, offering at the same time to give him such explanations as he desired. It was evident from the manner of his procedure that he had some doubts as to the fairness and reality of what was to be done, apparently thinking that it was a sort of a juggle to be played upon them by a "pale-faced *medicine man.*" Everything in the car was observed and scrutinized by him with a keenness that would have done credit to a philosopher. (Indeed, I looked upon him as a great *natural* philosopher.) A large brass speaking trumpet that lay in my car elicited from him particular inquiry. Having just before told him that I would sail above the clouds, he asked me who I intended to talk to there, with this instrument. I told him it was intended to talk down, not up. He also inquired the particular use of the grappling iron, and the philosophical instruments, contained in the car; the use of the latter he could not satisfactorily comprehend. He next asked permission to make a test of the *upward* power of the balloon, which was promptly granted him; several of the cords by which the machine was held down were brought together and placed in his hands. Upon these he gradually brought his weight, at the same time scrutinizing the others that were fast to weights, whereupon he nodded assent and belief in its powers, and at once acknowledged an abandonment of his skepticism upon the affair. Black Hawk, who until then had maintained a sullen silence and apparent unconcern of the whole affair, called me to him and informed me that this affair was very interesting to his companions, but that *he* had seen such things before. This was the truth; for some years before he witnessed, in company with General Jackson, who was then President of the United States, an ascension from the Battery in New York. The Prophet and young Black Hawk listened and observed very attentively to all that passed, but made no inquiries, being apparently satisfied with what they heard.

This investigation being got through with, I shook hands as a farewell, with the chiefs, and started off. At the moment of detaching the balloon, the Indians all simultaneously sprang on their feet and gave a wave of the hand with a faint but shrill shriek, which I took as a parting salute, and responded to it in a similar manner as nearly as I could.

The following is an extract from a Philadelphia newspaper, concerning this experiment:—

THE BALLOON:—SEE THE BALLOON!

"At about the hour of two, yesterday afternoon, these words were issuing from the mouth of every little urchin in the streets, which caused older heads to cast their eyes upwards in order to discover the cause, which was soon perceived in the rapid movement of a balloon towards our sister State, New Jersey, to which there appeared to be attached a *somebody*, or *something* that gave evidences of living flesh and blood. Various were the conjectures as to the occupant of the car attached—some supposed it to be Clayton of the '*far West*,' others, that Paullin was taking a ride to himself for the benefit of his health, made rather precarious since his fall at Trenton—and some intimated that it was a *man* from Lancaster, Baltimore, or somewhere else.

"Yet such was the fact;—Mr. Wise had undertaken this ascension in a private manner, and the way it was done has hardly been surpassed by any ascension heretofore witnessed in this city. The place of departure was at the corner of Green and Ninth streets; and although no public notice was given, yet the street was crowded to excess, and the inclosure selected for filling the balloon occupied by the aeronaut's friends, and the deputation of Indian chiefs now in the city, among whom were Black Hawk, Keokuk, &c. He ascended almost perpendicularly for several hundred feet, when a light westerly breeze wafted him towards the Jerseys, and in less than twenty minutes he was lost to our vision in the blue ethereal sky. The balloon ascended to about the height of one mile, and when last seen was traveling a southeasterly course.

"The Indians appeared to be much delighted with the scene before them, and Keokuk, in particular, seemed to view it with great astonishment, it being the first he had ever witnessed. On being informed by the interpreter that the balloon was going up with a man attached to it, he appeared to doubt its power to accomplish it, and to satisfy himself, went forward and took hold of several cords and bore his weight upon them; then nodding his head as assenting to the correctness of the interpreter's statement, took his seat.

"We had not heard of Mr. Wise's place of descension when our paper went to press."

On this occasion the inflation was effected by the decomposition of water under the iron and vitriolic process. The voyage was a pleasant and interesting one, although some incidents occurred that were calculated to inspire apprehension; but these served in a measure to enhance the interest, as well as to destroy the monotony of a mere aerial excursion. The atmosphere being very clear, prevented the possibility of making the particular experiments desired by Professor Espy, they being based upon a cloudy atmosphere. One of the air-bottles provided by Professor J. K. Mitchell, had to be parted with in the emergency of one of the incidents above referred to.

I noticed on this occasion, while crossing the Delaware River at the height of a mile, that the water appeared much more transparent when viewed from that height, than when viewed from a boat, or from its banks. And so remarkable was this phenomenon that, notwithstanding the constantly muddled condition of that river in the vicinity of the place where it was crossed, I could trace the geological structure of its bottom for some distance above and below the point of crossing. After I had crossed the river, the balloon moving south of east, sufficient ballast was discharged to raise her 9000 feet high, when her course became due east, with a speed so moderate, that it was only by the change of topographical scenery that I could discern its onward progress. The day was a remarkably pleasant one for the lateness of the season, and at this immense height the thermometer ranged at 42 degrees. It must, however, be observed, that the thermometer was not screened from the reflected heat of the sun by the balloon, which I afterwards discovered made a great difference in the indications of this instrument when carried aloft.

I enjoyed a range of vision from ninety to one hundred miles in diameter. Seeing that Philadelphia was now verging into the western horizon, and that Mount Holly and Vincent Town were passing beneath me in the same direction, and knowing that towards the east scarcely anything but forest and sea could now be expected, I commenced a rapid descent at half-past three o'clock, some distance to the east of Vincent town. The first thing that obstructed me in this design was the contact of a whirlwind, which enveloped the whole machine in a cloud of dust, sand, and dry vegetable matter. This so tossed about the aerial ship that I was obliged to take refuge in the bottom of the car, the better to maintain my centre of gravity. After being thus swung about for a minute or two, and carried up and south-eastward for a considerable distance, for so short a time, the whirlwind dispersed, and the balloon began to descend again. Having before this seen clouds of smoke ascending from the pines to the south-east of me, which I then took for collieries, I now found it to be the pines on fire, and the balloon fast descending right into it. Knowing the consequences of such a catastrophe from sad experience, the ballast yet remaining in the car was quickly disposed of. Finding this not to check the balloon sufficiently from falling into the fiery desert below, the speaking trumpet and air-bottles had to follow, which fortunately enabled me to cross the conflagration. The balloon now rose again to the elevation of 3000 feet, and rapidly traversed the pines towards Barnegat Bay, and for a moment I thought of continuing the voyage to the beach; but when the heaving ocean showed itself in the eastern horizon, swelling its bosom, as it were, up into the blue vaulted heaven, it looked to me like too much risk for the advantage likely to be gained by a landing on the beach sand. Consequently I determined to make a descent in the pines, which was accomplished at half-past four o'clock. The descent was made with considerable force, but the trees were so close to each other that the balloon did not slide down through them, until she was half discharged of her gas. Having before the descent kept an eye to the necessity of finding my way out of the pines, I rolled up the balloon, stowed it in the car, and then struck to the north for a road I had observed, which was soon reached, as well as meeting some huntsmen, who assisted me in conveying my machinery to Burr's saw mill, which is thirty-eight miles from Camden, and about forty from where I started.

CHAPTER VIII.

Experiment at Easton, Pa.—Failure and its consequences—Ascent from the public square at Easton—End of cause of failures—Decomposition of balloon—Prospects of future operations—Simplicity of the art—Success of pupils.

Although this last constructed machine seemed to be a very good one, and answered the purpose of an ascension admirably in its last trial, still it was defective in a part that only develops itself after the lapse of time (affinity for oxygen), and which doomed me to the chagrin of one more failure, and the last, happily, that I had the mortification to endure, except in one case where the voyage was incomplete, though not essentially a failure of ascent.

In the spring of 1838, I went to Easton, Pa., to gratify the citizens of that beautiful town with a "balloon ascension." The balloon having now lain over winter, had become harsh and fragile—a property that gum-elastic varnish is subject to, rendered drying by metallic dryers, which also under increase of temperature is extremely liable to spontaneous combustion. This caused me to fail in getting the balloon sufficiently inflated the first time I tried it in Easton, and although thousands of people from all parts of the surrounding country had assembled to witness the sight, no evil consequences, except my extreme mortification, ensued from the disappointment.

To make a brief account of this part of the affair, and to show the character of the Eastonians under such circumstances, I will here make one extract from an Easton newspaper, consequent upon the occasion, to wit: "*Wise's Balloon Ascension.*—On Tuesday evening last, a meeting of the friends of Mr. Wise was held in the court house, when it was decided that the ascension should take place on Saturday the 26th of May, inst., between the hours of eleven and one o'clock on said day (from the centre square). The same collecting committee for the different blocks, will take up a collection on the day of the ascension. Their names are: Joseph Barnet, L. A. Buckley, Edward J. Seip, Thomas Sletor, John Finley, H. Hamman, John A. Shouse, John A. Innes, H. S. Heckman, Doctor J. P. B. Sloan, W. Green, Geo. W. Barnet."

Such was the result upon the failure at Easton. Though an entire stranger in the place, the first intimation from the people to me upon the unfortunate experiment I had just attempted, was that I should try it again at the expense of the citizens, which was cheerfully complied with, and accomplished to their utmost satisfaction and a handsome remuneration to myself.

Of this voyage I published an account in the Easton newspapers. It was a magnificent and interesting one; but, as the details embrace no peculiarities nor phenomena but what have occurred in those already given, the newspaper notice of the occasion will suffice. "On Saturday last, 26th of May, 1838, according to advertisement, Mr. Wise made his promised balloon ascension from this borough. The arrangements for inflating the balloon were simple but effectual, and shortly after 11 o'clock A. M. all was ready for a ride in the clouds. At about fifteen minutes before 12 o'clock Mr. Wise placed himself in his car, and cutting the cord which restrained the aerial vessel, at once rose majestically into the heavens. Many thousands were spectators, and we believe that not one but acknowledged the perfect beauty and sublimity of the ascension. Mr. W. repeatedly waved his flag and hat in return to the cheerings of his friends below, until at length his buoyant vehicle penetrated a dense cloud at some two thousand feet elevation. Here he was lost sight of by the spectators, and although occasional glimpses were had of the voyager at different places, nothing definite as to his whereabouts was known until the arrival of the Morristown stage with the aeronaut, balloon, &c., at about 10 o'clock P. M."

This voyage was ended at the foot of Schooley's Mountain, a distance of about twenty miles from Easton eastward, in one hour and a half from the time of starting. The thermometer stood at 74° at the moment of ascension, and fell as low as 36° during the flight of the balloon. Two ascensions had now been made with the machine. Before its last trial it had to be recoated with a purely linseed oil preparation, in order to make it pliable and impervious to the gas. Upon this it answered the purpose very well; but as the weather grew warmer, the balloon being packed up, it commenced its attraction for heat, and when in the early part of July following, I returned to Easton to make preparations for another ascension, the people having determined for one in the following August, I found the balloon in a state of decomposition. It had been packed up in a box, which upon being opened did not develop that characteristic inclination of ignition, as had been observed by me in oiled silks before. This time it had commenced going into ashes by forming holes in various parts of its central mass, and it was not until the box had been opened, the balloon unfolded with its decomposed parts exposed, and then folded up again and left lay in that way for several hours, that it gave symptoms of ignition. And these symptoms were so intense that the whole mass was thrown into a trough of water to prevent its inflammation.

With the destruction of this machine by spontaneous combustion, also ended the mode of preparation which caused it, and which heretofore had been the most perplexing and obstructive hinderance to my progress in practical ballooning. During the past winter I had instituted various experiments upon elastic varnishes, and in the end discovered that linseed oil alone contained the elements necessary to a pliant, fast drying, and non-adhesive varnish, and was not only free from the property of acquiring heat or oxygen spontaneously, but possessed the other property of being a non-conductor of these elements.

After this discovery, my career as a practical aeronaut became easier and more successful. This had the good tendency of establishing in the common public mind, that it was governed by principles as comprehensive and systematic as were those of sailing a boat, or running a steam engine; and the dissemination of these principles it is now my object to bring to the understanding of every mind that is capable of conceiving the single rule of three in arithmetic, so that we shall soon see the atmosphere as full of balloons as are the rivers and bays now of pleasure yachts. But its danger, exclaims a hundred voices! But my hundred ascensions under disadvantageous circumstances is the reply! And if that is not satisfactory, then I can say that already half a dozen persons have taken my balloons with no other knowledge than the simple instructions given them on a sheet of paper, who have made balloon ascensions as successful as myself. Some of these have since constructed their own balloons.

CHAPTER IX.

Construction of cambric muslin balloon—New principle involved in it—Second ascent from Easton—Thunder storm—Parachutes—Explosion of balloon above the clouds—Descent with it collapsed—Letter from an unknown friend about it—Ascent from Allentown, Pa.

July having already numbered a third of its days—my second ascension from Easton advertised to come off on the 11th day of August following—my balloon totally ruined and unfit for use, placed me in a predicament which required all my energy and knowledge in the business, in order to make the affair terminate in a satisfactory manner. The people of Easton and its neighborhood having treated me so generously before, I was determined, if possible, not to forfeit a continuance of such treatment by any delinquency of mine thereafter—not even by a postponement of the time of the contemplated ascension. Consequently, the construction of a cambric muslin balloon was determined on, as in this material facilities were afforded that did not exist in silk. The muslin being much wider, required less sewing. Its preparation with varnish could also be effected quicker than that of silk, as it could be *soaked* in varnish for the first coating, and would require but one more coat, put on with the brush, while silk required three coats at least, and all put on with the brush. Under these auspices the new balloon was commenced, and as it was to be coated with the newly invented varnish, it was also determined that it should become the test of a new principle of descent. Having, however, always met with so much opposition to every new proposition in aeronautics that I suggested, I determined to keep the new idea to myself, until it should have passed the ordeal of actual experiment. It was the explosion of balloons at great heights, depending upon their friction through, and resistance of, the atmosphere, for a safe descent. The idea of such an experiment—bursting one's balloon a mile or two above the earth, and permitting, inevitably, the gas to rush out of it instantly, may startle the reader, even the student of the science; nevertheless, it was made, repeated, and can be made again, with a certainty as great, and principles as comprehensive, as that a pocket handkerchief will not fall as rapidly to the ground when thrown out of a third story window, as will a brick.

The cambric muslin machine was completed in due time, being of a globular shape, twenty-four feet in diameter, and different from all former ones made by me, only in not having a double top for several yards across, immediately around the valve. This precaution in the construction of balloons arises from the greater strain falling upon that part of the machine in consequence of the network being slightly fastened to it at that point, to keep it to its proper place while the balloon is inflating, as also the valve being inserted there, which must undergo some stress in working it. Although I had not announced that I would attempt the explosion of the balloon when up in the atmosphere with it, neither had I positively determined to make the experiment on that occasion, but everything necessary to such an experiment was observed in the construction of this machine.

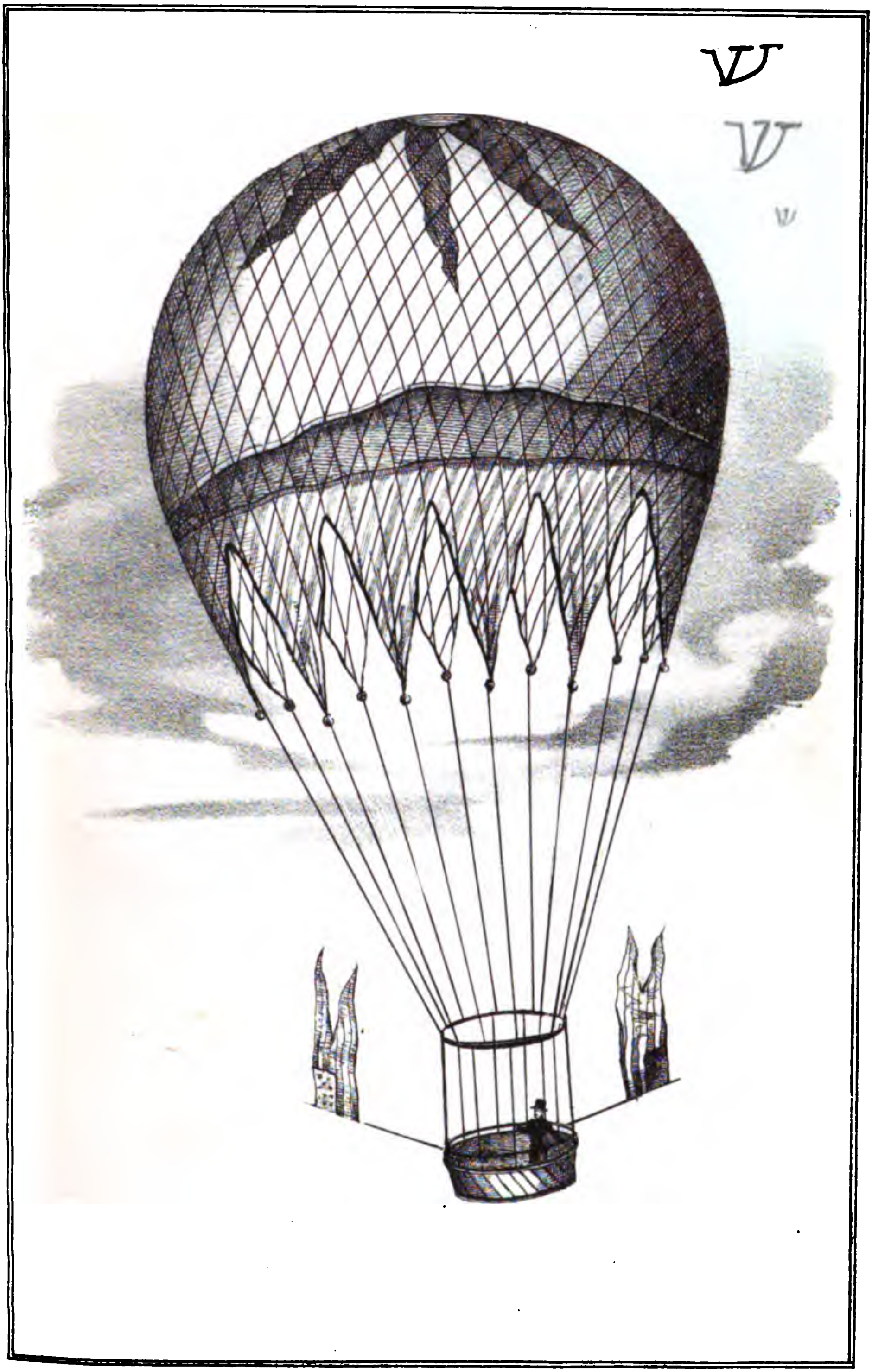
The fixtures necessary to this are simply contrived in the following manner. The top of the balloon is of the single material, muslin or silk, as the case may be, and at three different points round the valve are small holes the size of a five cent piece; through these holes strong twine cords are passed, coming down over the outside of the balloon four or five feet, where they are firmly sewed to corresponding seams. In the inside of the balloon they are brought together in one common joining, from which proceeds a single cord down through the neck of the machine into the aeronaut's car, where it can be used for the purpose of its design. Where these cords pass through the envelop of the balloon around the valve, suitable pieces of oiled silk are cemented over the holes to make it air-tight.

Thus prepared, and the 11th of August, the day for the ascension, being at hand, nothing remained but to go on with the experiment. The day was fine in the morning, but at noon the heavens indicated an approaching thunder storm, which, by ten minutes before two o'clock, passed over with no other injury than the wetting of the network of the balloon, and the dispersal of a portion of the audience, who, for a brief space of time, were driven to places of shelter.

At a few minutes before two o'clock, the balloon was detached from terra-firma. I had with me two parachutes containing animals, one a cat, the other a dog; and as the balloon approached a dense body of black thunder clouds, some vivid flashes of lightning, accompanied by violent peals of thunder, greeted my upward passage. This gave the first part of my voyage a terrific, but grand and imposing appearance. It seemed to me as though heaven's artillery was celebrating the occasion as a progress of the new-born science, and it inspired me with a determination to try the new experiment of atmospheric resistance as a means of safe descent in the event of explosion of the balloon at great heights. As soon as an altitude of about 2000 feet was attained, the conical parachute with its occupant (this was one on Cocking's plan) was detached, which landed in safety near Lafayette College, at the head of the town. Soon after this the balloon attained an altitude of about 4000 feet, at which point the oiled silk parachute with its occupant was detached. This was to foreshadow the effect of the experiment of exploding the balloon, and was so contrived as to have an apparent disadvantage compared with that of the large machine. This small one was nothing more than a balloon in a collapsed state. When thrown overboard, it fell some distance before it expanded completely, and after it had expanded, it fell with a very irregular vibratory motion, which was not the case with the other one. Upon this, I concluded, however, that the experiment would not be hazardous, if not disagreeable. I was also assured, from my experience, that a balloon in a flaccid state, or only partly so, would invert, that is, the lower part cave into the upper part, and assume a hemispherical shape in a rapid descent.

When an altitude of about 13,000 feet was attained, the balloon became fearfully expanded—to its utmost tension; and, having but an inch diameter-tube in the neck, the gas began to issue through this orifice with considerable noise. I would here observe, however, that any slight sound, occurring in so perfectly quiet a place as is that of a balloon a mile or two above the earth, makes apparently a great noise. At this period of the voyage it was evident, that unless gas was speedily let off, the balloon must burst from expansion; for she was still rising, and the explosive cord, being tied rather short, had also become tense, and must evidently be tending towards a rupture at the points it passed through the balloon.

At this critical moment I became somewhat excited, and as I looked over the side of my car, I observed the sparkling coruscations of lightning springing from cloud to cloud a mile beneath me, as the thunder storm was passing its last remnants below. The storm was moving from S. W. to N. E. and the balloon was sailing from N. W. to S. E., passing New Village and Asbury, and I could now see the earth in that direction. I took out my watch—noted on my log book the time—twenty minutes past two, and as I was about returning it to my pocket, thinking at the time whether it were not best to relieve the explosion rope—discharge ballast, and abandon, for the present, the idea of this experiment, *the balloon exploded!* Although my confidence in the success of the contrivance never for a moment forsook me, I must admit, that it was a moment of awful suspense. The gas rushed from the rupture in the top of the balloon with a tempestuous noise, and in less than ten seconds, not a particle of hydrogen



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DESCENT NEAR EASTON PENNSYLVANIA.

remained in it. The descent at first was rapid, and accompanied with a fearfully moaning noise, caused by the air rushing through the network, and the gas escaping above. In another moment I felt a slight shock. Looking up to see what caused it, I discovered that the balloon was canting over, being nicely doubled in, the lower half into the upper; it had fallen, condensing the column of air upon which it was falling, until it had arrived at a point where it was so dense that the force of the whole weight pressing down on it was arrested, which caused the parachute to tilt over. The weight of the car, however, countervailed the tilting tendency, giving it an oscillating motion, which it retained until it reached the earth. The velocities of these zig-zag descents were marked by corresponding notes of the wind, as it whistled through the rigging of the balloon. On reaching the point where the lower current of air traversed the upper, another and more violent shock than the first, was the result. From this point the oscillations became more severe, each one causing a sensation in me similar to that a person experiences when dreaming they fall.

The wind from the S. W. drifted the machine several miles in its direction before it fell to the earth. As I neared terra-firma, all the ballast was thrown overboard, but when I struck, it was with a violent concussion, for the machine was just then at its maximum velocity of descent. The car struck the earth obliquely, and I was thrown about ten feet forward from it. The balloon had fallen alongside of me, and so complete was the collapse where the lower part had doubled into the upper, that it was with difficulty separated again. The car had turned bottom upwards, and there I stood congratulating myself on the result of this exciting experiment—the perspiration rolling down my forehead in profusion, for the atmosphere below felt oppressive. The landing was made on the farm of Mr. Elijah Warne, about ten miles from Easton. Before many minutes had elapsed after this descent, I had resolved to repeat the experiment, in Philadelphia, at the first opportunity.

On my return to Easton, the day after the ascension I received the following letter:—

"New Village, August 11th, 1838.

"Mr. Wise, Master of the Aerial:

"I hereby certify, that my first sight of your air ship was north of Henry Snyder's; it then apparently passed not far from William Kinney's, then directly between the inhabitants of New Village and the sun; we saw the gas rushing from the balloon like the steam from a boiler; it created between us and the sun the colors of a rainbow, and it was some time before we got a second sight, when you appeared to be lowering. As the size of the balloon became larger, we could discover a black spot underneath, about twenty feet. I pursued on foot until I saw you alight near Thomas Thatcher's.

"From your most affectionate,
"but not acquainted, friend,
"WILLIAM SHARPS.

"N. B. And others."

From this it appears that spectators on the earth could not see the balloon at the time it was falling during the collapse. Its descent for the first few seconds must have been faster than at any other period of its fall, and during that time it affected me more, too, for the sensation caused a dimness of sight, and I closed my eyes momentarily from the effect.

On the 8th of September following, I made an ascension from Allentown, Pa. I had resolved that after this one was accomplished, to go to Philadelphia and repeat the experiment of exploding the balloon at a great height in the air. The Allentown ascension was a very complete one; the following extract from the journal, always kept during my ascensions, embraces the most interesting features connected with that trip.

The balloon was now perfectly stationary over the outskirt of the town. I next concluded on starting a fresh interest to the spectators below. Having all the ballast bags filled with dust, several of them were emptied overboard, which, for a moment, enveloped the balloon in an artificial cloud, which presented a very interesting phenomenon to the lookers-on. This sent the balloon up about two thousand feet more, approaching at the same time a solitary cloud. As I passed the angle of reflection of this cloud, a very sensible heat was felt, showing clouds to be good reflectors of heat, as they are of light. When the balloon got in proximity to the cloud, it became somewhat agitated, making rotations one way, then another, at the same time the cloud apparently receded from the balloon, as by repulsion. Here several more bags of dust were discharged, which clung much more to the balloon than did the former; even the heavier particles were now attracted to the surface of it and remained there some moments. When the machine had risen considerably above this point, the dust fell from it in a cloud. This was a very interesting part of the voyage, and convinced me that the science of electricity and meteorology would be much improved by the aid of balloons.

CHAPTER X.

Consultation upon exploding balloon again—Announcement to do so in Philadelphia—Newspaper comments on it—Explosive contrivance—Balloon bursted from top to bottom—Its descent, and motion—Place of descent—Explosion of balloon while aloft not fatal to the aeronaut—Atmospheric resistance not fully appreciated by theorists.

Having arrived in Philadelphia in the month of September immediately following my experiments at Easton and Allentown, I consulted several scientific gentlemen upon my intention to announce that I would make an ascension, and explode the balloon when over a mile high. Although they did not seem to doubt the philosophy of atmospheric resistance, nor the theory of converting the balloon into a parachute, still, they most earnestly attempted to dissuade me from my intentions, as they considered it a risk of life. Could they have persuaded me with half the philosophy against it, that I had contemplated for it, it would never have been attempted by me.

Feeling convinced that all was right, an announcement was made that such an experiment would be made on the 1st of October, 1838, from the corner of Seventh and Callowhill streets. The day was a remarkably fine one, and the balloon moved in five different directions during her flight. The editorial notices of five principal newspapers of Philadelphia will be first given, before I shall give my own account of it.

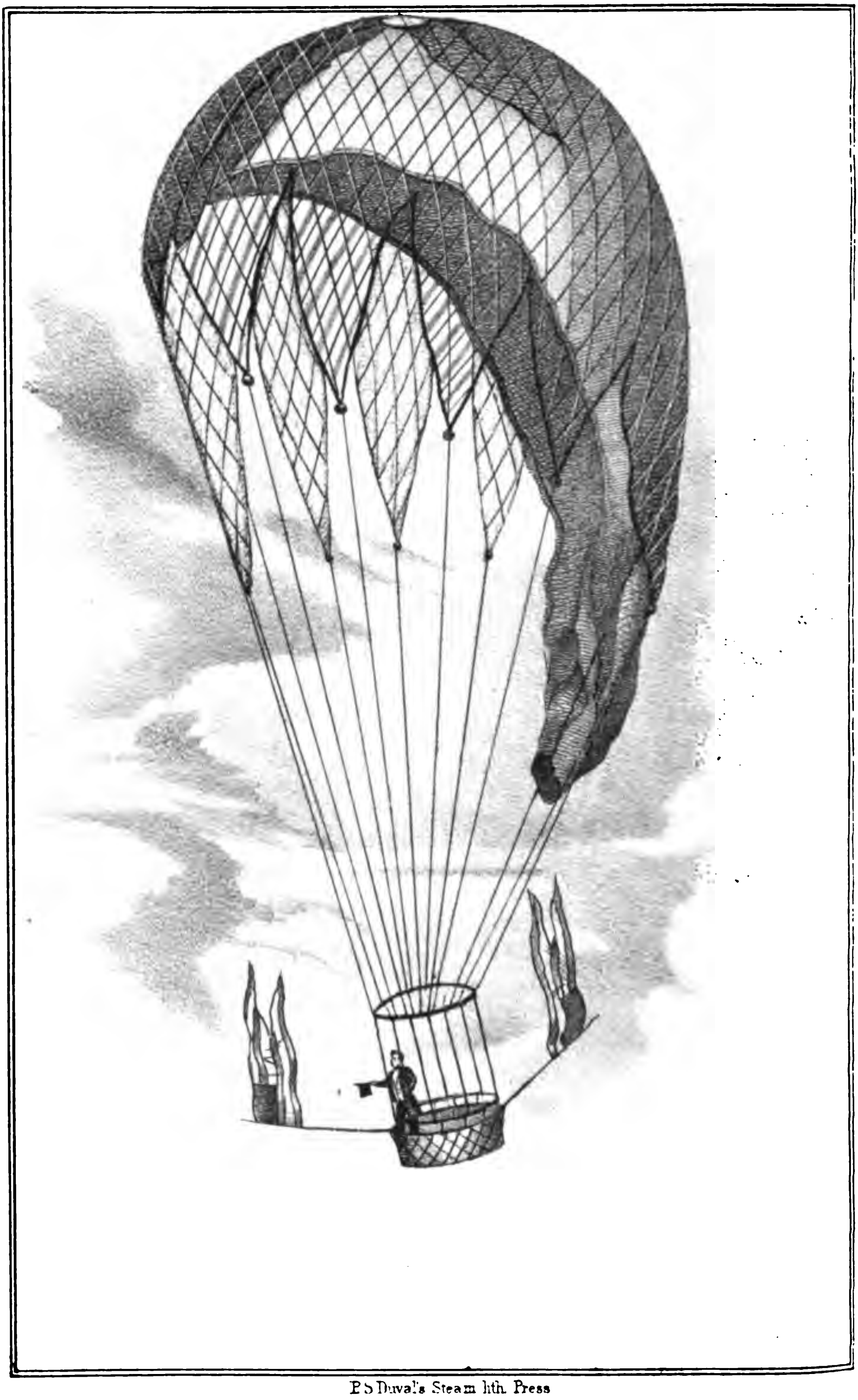
1st. "Mr. Wise ascended yesterday afternoon, at half past four o'clock with his balloon. The sky was perfectly clear, and the balloon passed slowly to the northwest; in about twenty minutes, the rich blue of the heavens was marked with a thin, filmy white, which was the gas escaping from the top of the balloon. At five o'clock, and for half an hour, we watched at a distance from the city, the balloon, far to the west, which resembled some large planet pouring out a flood of light. This was caused by the rays of the sun. The reflection was exceedingly brilliant, and the whole balloon seemed a ball of fire, while the hoop in the centre looked like a dark belt (it had no hoop in the centre). This was one of the most beautiful sights we have ever seen of the kind."

2d. "Mr. Wise yesterday afternoon, as per notice, made an ascension in his parachute balloon in the handsomest possible style. There was scarcely a breath of air stirring, and he rose almost perpendicularly to a great height, and was out of view at the writing of this paragraph, having been up about an hour. He went up without any difficulty—how he gets down we'll tell to-morrow."

3d. "Mr. Wise, the aeronaut, made a successful ascension on Monday. The balloon passed over the Schuylkill, and Mr. Wise eventually descended, according to his promise, by letting off the gas gradually at an extreme height; by means of a cord and pulley, he converted the balloon into a parachute, and thus came down. It was a most fearful undertaking, and was anticipated by competent scientific authority as calculated to carry with it destruction of life."

4th. "Mr. Wise made yesterday afternoon one of the most beautiful ascensions that Philadelphia ever witnessed. About half past four he left 'old mother earth,' and like an arrow from a well strung bow, reached the welkin, cheered in his upward flight by the shouts of the dense mass which filled the neighboring streets. At six o'clock he was yet in sight, there being no breeze, and apparently in the *statu quo* of ten minutes after his departure. The explosion, which was to make of his aerial vessel a parachute, did not take place, owing, we suppose, to the fact that he could not get beyond the precincts of dangerous obstructions to such a daring attempt. At one time the appearance of the balloon was beautiful; the gas issuing from it seemed like smoke, and the sun shining upon the lower part of the balloon, which was considerably depressed and exhibited a tremulous motion, gave it the appearance of being on fire. We did not learn where he descended."

5th. "Mr. Wise's ascension yesterday afternoon from the enclosure, corner of Seventh and Callowhill streets, was one of the most beautiful we ever saw. We did not witness the process of inflation, as at the time of our entering the enclosure, half past four o'clock, the pipes communicating the gas to the balloon had been withdrawn, and the aeronaut having entered the car, was arranging his cords and other fixtures. This was speedily accomplished, and at twenty-two minutes before five o'clock, the cord which confined the voyager to the earth was cut by Mr. Wise, and bidding the assembled thousands 'good-by,' he soared aloft almost perpendicularly, though bearing a little south for some twenty minutes, after which, at a height of some several thousand feet, a different current of air wafted him to the north, until he was brought to a position almost directly perpendicular to the place of starting. At this altitude he encountered another current of air, by which he was rapidly carried in a west by north direction for several minutes, when a small cloud of gas was suddenly dis-



P. S. Duval's Steam lith. Press

DESCENT NEAR PHILADELPHIA.

covered to have issued from the balloon, and soon after another of about the same quantity, after which the object of attention seemed gradually to descend for a short time, until it had arrived at an atmosphere of sufficient density to exactly weigh it. It now pursued the even tenor of its way in a direct course, W.N.W., until nearly out of sight from the enclosure, when at about half past five o'clock, the balloon seemed suddenly converted into a parachute, and commenced a rapid descent. We watched its descent with a spyglass, until so low that the buildings hid it from our view, say at an angle of some ten or twelve degrees from the horizon. We know not at what distance from the starting point the descent was made, but should judge it to have been several miles. We hope, at least, that the intrepid voyager reached the earth in safety, though we had some fears from the apparent rapidity of his descent."

Such were the notices of some of the public journals of the day. They all but one agree as to the conversion of the balloon into a parachute, and that one saw it at the time it was forming into such a shape, when he perceived the depression in its lower part. In this last arrangement I had a pulley fixed into the valve disk, on the inside of the balloon, through which a cord passed, whose one end was fastened to the lower part of the balloon, by which that part might be drawn up into the upper, as the gas rushed from the top. I found this part of the contrivance utterly useless. When the balloon was exploded, the lower part did not immediately invert, as in the former experiment of this nature, for, on this occasion, it bursted open from top to bottom, and caved in sidewise. I was, at the first discovery of this, somewhat alarmed, fearing that it might come down with a continuous accelerated velocity, from which anxiety I was, however, soon relieved. It caught the wind like the main sail of a ship, and *slid* down upon the atmosphere, in a spiral course, with a *uniform* velocity. The descent was made a mile or two on the west side of the Schuylkill, and not less than several hundred persons had followed from the city, and were on the ground, where and when it was made. The concussion was not near so violent, as the apparent rapidity of the descent would seem to have warranted, and was not harder than that which would follow the jumping from an elevation of ten feet to the ground.

As the machine was descending, the lower part, one third the length of the whole balloon, hung loosely in the net-work, swinging to and fro, and occasionally pressed upwards, slightly, by the current of the air. The resistance of the machine against the atmosphere acted on the principle of the inclined plane, sliding obliquely down over it, describing spiral circles, until it struck the earth.

Since this experiment, balloons have exploded for aeronauts while aloft with them, and in no instance have their persons been seriously injured; but every newspaper and periodical account of them, setting them down as miraculous escapes. And the miracle is always in the height from which the machine falls to the earth, the resistance that the atmosphere must present to it never hardly taken into account. We might as well call the descent of the flying squirrel, from the high forest tree to the earth, without sustaining any bodily injury, a miracle, for its surface, compared to its weight, is not in a greater ratio than is the weight of a man compared to the surface of a common sized balloon, whatever shape the latter *can* assume.

This is a principle in aeronautics which has never yet been duly considered, although a very ingenious mathematical deduction upon the descent of parachutes has been given in this work. Meteorological and astronomical deductions are yet much to be facilitated by the science and practice of aeronautics. There are things in its philosophy that men have not yet dreamed of. There are sublimities in its practice that the world has not yet been fully prepared to realize.

Although the principle of atmospheric resistance is a self-evident thing, and its application to a safe descent from great heights has been demonstrated, there are yet very few persons who are willing to believe it so well established as to entitle it to be practiced with impunity.

CHAPTER XI.

Second ascent from Allentown, Pa.—Electrical phenomenon—Descent and collapse of balloon—Third ascent from Allentown—Neglect at starting—Descent of small parachute—Predicament from neglect—Thundergust—Phenomenon attending it—Reflections in a critical case—Paradoxical descent—Appearance of the gas when released at great heights—Peril overcome—"Misfortunes never come single-handed"—Descent and its consternation—Danger of being shot—Went up again—Final descent—Next experiment—Novel ascent—An amateur—His opinion of aerial voyages—Its healthfulness.

In the spring of 1839 I was invited to make another ascension from Allentown, Pa., which was readily accepted. The ascension was made on the 27th of April, at about two o'clock in the afternoon, and the following extracts from the log-book of the trip will be found interesting. At twenty-five minutes past two o'clock my vessel stood over the town of Bethlehem, and had also reached the clouds, and the course changing from E. to S. S. E., the thermometer standing at 36°. This temperature felt unpleasantly cold; my ears began to ache violently, accompanied by a crackling, noisy sensation; my nose began to bleed, and I felt very much distressed for a few minutes. The balloon became rapidly distended, and highly electrified, and an open sack of sand lying in the car showed strong electrical effects by a portion of it being drawn up against the balloon, from which it would drop down again, keeping up this motion for over a minute. When the balloon left the earth the gas in it was of a milky color, but now, when it had risen to a height where the machine had become fully distended by diminution of atmospheric pressure so that I could look in through the neck of it, the gas had become perfectly transparent. While this change of color in the gas was going on, it gave out water, which dropped freely from the lower orifice of the balloon, and it also emitted a strong sulphurous odor. Some powerful electrical effect must have produced these phenomena, and I always found strong electrical effects when passing from one current of air into another.

On this occasion, the wind was very strong when I descended, which was forty-two miles from Allentown, and having the explosive apparatus in the balloon, and failing in the first landing to get a hold with the grappling-iron, I found it very convenient to explode the machine the second time it touched the earth.

On my return to Allentown, the citizens of that place expressed a desire to have a third ascension. This was made on the last Saturday of May, 1839, and, as it was attended by circumstances for a while placing my life in jeopardy, as well as bringing into use a mode of causing the balloon to descend which would seem paradoxical, an account of it will be here given. At the time it happened, no particular account of the circumstances alluded to were given in the papers relating the voyage, for the reason that I was fearful it might *increase* the belief that ballooning was extremely dangerous.

At half-past 2 o'clock in the afternoon, everything being in readiness to detach the balloon from the inflating apparatus and prepare for the ascent, and just at the time this was all accomplished, and nothing more remained to be done but to draw the valve cord out of the neck of the balloon, where it generally remains during the inflation, a gentleman from the South was introduced to me, who commenced a conversation which drew my attention from the preparation of the valve rope, and while conversing with him, I being in the car at the time, the balloon was let up the length of the restraining rope, where, after a few minutes of adjustment of things in the car, I bid him and all others a good-by and cut off the rope. The last fibre of the cord which held me to the earth had scarcely been severed before the thought flashed on my mind that the valve rope had not been secured. But it was too late, now, to remedy the mistake—the balloon was mounting rapidly—for a moment I began to despond—and I would have given everything possessed by me in the world to be down on the earth but one minute—it was an intensely painful moment—but I rallied my spirits quickly—took off my hat and swung it around, which was vociferously responded to from below.

I had with me a parachute containing an animal, and knowing that the disposal of this would send me higher from the earth, I at first felt an inclination not to part with it; but upon reflection of its being announced to be done, and the people of course waiting for its descent, it was at once thrown overboard. I watched its progress until it reached the earth, when it was picked up by some men, and oh! how I wished myself there too. However, having over a hundred miles between me and the Atlantic Ocean, I felt hopes that something might be done in the interval that would enable me to get down. My first observation in view of this was to ascertain the velocity of the balloon in her eastward course. This was found to be about fifty miles per hour, and convinced me that the Atlantic was likely to be reached before the ascending power would give out so as to let me down. I could not persuade myself that the balloon was in a bad enough condition to meet such a hope, for it had just undergone a thorough repair, and was in *good* condition, a quality, in this instance, not very desirable. While thus meditating upon the best means of effecting a descent, I found that already a great portion of Jersey had been traversed, as Princeton was not far ahead of me. The current of wind below, just in the cloud region, was moving from the southwest, and the one the balloon was sailing in was from the northwest. To the north the atmosphere was clear, to the south it was charged with clouds. The lower current was carrying in it a thundergust which presented a beautiful phenomenon. As I was over a mile above it, and four or five miles off, it gave me an opportunity to scrutinize its operations sidewise and above. The storm and the balloon were also moving towards the same point, so that I was continually nearing it, but so high above it that no danger was to be apprehended from its effects. The rain was pouring down from it and made a noise like a mill-dam. The clouds were rolling over and against each other; the lightning flashing in zig-zag flashes through them as long as their side view was open to my sight. Presently, it was all overcast below me, the thunder rattling like small arms without any of the rolling reverberations that are heard below. The most splendid part of this scene appeared just where the storm was passing some dense clouds that were moving in the upper current, that had recently made their appearance. Several times the surface of the lower stratum swelled up suddenly like a boiling cauldron, which was immediately followed by the most brilliant ebullition of sparkling coruscations. Twice it swelled up, or rather shot up like an immense pyramid, which was also quickly followed by an evolution of promiscuous flashes, and then quickly disappeared again, as though it had dissolved. It was a magnificent sight; but, in recurring to my critical situation, its charms passed from my mind with its departure to the north of me.

As soon as the storm had passed off, which was in about fifteen minutes, the sky became clear to the south and east. Princeton was some distance to the north of me, and I was moving nearly due east. Less than an hour would now take me on to the Atlantic; it was already in sight to the northeast and the east. The balloon, seemingly, had not yet lost any of her altitude of the last hour. I had plenty of ballast to go up, but no control of the valve to get down. It was an embarrassing moment. First, I looked at my stock of provisions, which consisted of about a half pound of water crackers and as much cheese, together with a bottle of porter, which was handed me by a friend at the time of starting. This all seemed well enough to hold out with, even to cross the ocean, for, at the rate I had been moving, less than three days would take me across. But the balloon, good as she was, it could not be reasonably expected that she would hold out, although between forty and fifty pounds of ballast were to be depended on. The neck of the balloon, as is usual in common aerial voyages, was left open, and the natural affinity of gases for atmosphere must, in less than three days, so deteriorate the hydrogen in it, as to bring it down. This hope now fled. What *was* to be done! A thousand things were running through my brain—even that of jumping overboard when on the confines of land, and plunging in the ocean—faint hope—it were worse than sticking to the ship.

The proud and boundless Atlantic was now distinctly seen swelling its mighty crest to the arched roof of heaven, in the east, dashing its angry foam into the face of the clouds. This aroused all my energy, all my fertility of mind. I had been endeavoring to split my little flag-staff, in order to splice it and tie a penknife to the end of it, with which to cut the balloon; but it would not answer. My next effort was to burst the balloon by violent jerking of the car—the explosive rope was not in the machine now—but this also failed, and only went to show how immensely strong a network and balloon really were. Now a new idea flashed on my mind—*I can get down by going up*—and in another moment one bag of sand after the other went overboard, until half the ballast was gone; the balloon was mounting rapidly—the visible horizon was fast contracting—the yawning Atlantic was thus shut out of view. The atmosphere grew extremely cold at the height I had now attained; but the excitement of the occasion kept me warm enough. The balloon was now completely distended, the gas was copiously discharging itself at the neck; which, having no tube in it, was now open in a circle of eighteen inches diameter. As the gas mingled with the outer air it had the appearance of a white cloud. By violent jerks in the car, impulsive volumes were discharged from the neck, the balloon still rising. In ten minutes after I had commenced this, the balloon had attained her maximum height, and immediately after began to sink rapidly. The valve-rope in the meantime partly rolled out of the neck, so that I could reach it with the flag-staff; my peril was at an end, and I felt as happy as Archimedes, when he cried out *Eureka*, and I really *did* cry out "Victory! victory!" as the threatening Atlantic came to view by the rapid descent. The immense discharge of gas, and the rapid admixture of atmosphere and hydrogen within the balloon, consequent to the free connection by the large opening of the neck, and a rapid descent, brought the machine down to the earth fast enough without the use of the valve-rope, which had now been brought within my reach. Although the peril of perishing on the ocean was now ended, and I was almost in contact with terra-firma, the old proverb of "misfortunes never come single-handed" was yet to be realized.

On reaching the earth, my grappling iron took effect in a Jersey farmer's peach orchard, which so alarmed a negro who was ploughing in the next field, as soon to infect his horses, two boys, and two dogs near him, and to create a perfect bedlam amongst them. The horses ran away with the plough, snuffing the air like war steeds—the boys screamed—the dogs barked—the horses snorted and reared up in the fence-corner—the negro lay on his back looking up in terror—the balloon was serging up and down, ripping the grappling iron from one peach tree to another; and now the contagion had spread to the house and the barnyard, the poultry were in a clatter—the matron of the domicil standing before the door of the house, clapping her hands together in anguish for the safety of the boys, who were still screaming—the old man next made his appearance with gun in hand, and in a gruff voice exclaimed, "Where is it, where is the d——d thing?" Terror next beset me, for a shot from the old man's blunderbuss was more than suspicious, the moment his eye should catch the balloon, to which his back was yet turned, and I made no delay in cutting in twain the grapple-rope. As the balloon rose, the old man cried out in a satisfactory manner, as he stood in a half-stooped position, "There, there it goes." And I did go, although the country for two or three miles around was alive to the descent of the balloon, with footmen and horsemen wending their way towards it. I went five miles further, and landed finally on the ground of John Dye, Esq., on a spot called the "Devil's Half Acre," six or eight miles from Hightstown, in Middlesex County, New Jersey.

The length of this voyage, as made by the course of the balloon, was about a hundred miles, and occupied two hours and a half, it being five o'clock when I landed. After this a number of ascensions were made by me in various parts of Pennsylvania, but, as many of them in their accounts would embrace only a repetition of what has been said, such only as will afford new peculiarities and instruction to the student will be related.

While getting ready for a second ascent from the village of Kutztown, in Berks county, Pa., in the summer of 1839, it began to rain very hard, and continued the remainder of the day. A young man, who had attended as a spectator, expressed a great desire to accompany me in the voyage, and as the weather turned out to be very unpleasant, I offered to let him occupy my place, which he accepted. As the newspaper account gives the substantial particulars of it, it may be properly quoted.

"A NOVEL ASCENSION.—Mr. Wise was to have made a balloon ascension at Kutztown on Saturday, the 20th inst., and was to have been accompanied on his voyage by Mr. Wellington Dunlap, a young man of Berks county. In consequence of the rain that afternoon, the balloon and net had become so wet and heavy that it would not carry two persons, and, at the earnest solicitation of Mr. Dunlap, Mr. Wise consented to Mr. D.'s making the voyage alone, and gave him the necessary instruction for the management of the balloon. He ascended through a heavy shower of rain, as was estimated, about a mile, and, after remaining in the air about thirty-five minutes, descended within three miles of the place whence he started, highly delighted with his voyage, and the result of his experiment. Mr. Dunlap is under the impression that his trip was a greater benefit to his health than all the medicine he has taken for ten years past. The novelty of the voyage, the pure air which he breathed, and the freedom with which all the circulating fluids of the system are allowed to act in so rare an atmosphere, all combine to produce a salutary effect. There is some philosophy in his idea, and if we were sure, as we often heard Mr. Wise say it was the case, of there being no danger in the experiment, we should be half inclined to recommend it."

Now this young man had never witnessed an ascension before this, and had I not been confident that there was no particular danger in the experiment, he should never have gone up by my consent. The only risk that I incurred was the loss of the balloon, by his getting disconcerted in the descent, of which he was cautioned before he started.

CHAPTER XII.

Double balloon ascents from Philadelphia—Conversation while aloft—Singular air-current—Subject for meteorologists—Electricity and air-currents—Descents of the rivals.

On the fourth of July, 1840, it was announced that Mr. Paullin and myself would ascend, each in his own balloon, but in company with each other, from the Pennsylvania Farmer Hotel yard, in Philadelphia. The ascensions were to be made at meridian day, and the balloons were to be inflated with carburetted hydrogen gas, procured from the Northern Liberty Gas Company's pipes. I had now abandoned the cambric muslin balloon, which had served me well for a dozen ascensions, and was then sold to an amateur aeronaut, and had a silk one in use, prepared with the newly discovered varnish, and it was of a size sufficiently large to carry a passenger and ballast when filled with pure hydrogen, being twenty-three feet in diameter, but too small in capacity to carry a passenger and ballast in the car when inflated with the carburetted hydrogen. This latter gas could raise up only forty pounds where the pure hydrogen could raise up sixty pounds, so that it was one-third less in power. By dispensing with the car, and substituting for it a light board to which the cords of the net-work were fastened, it would be relieved of some weight. In order to make this gas answer the purpose for this occasion, this had to be done, or the balloon would have to be enlarged, and as the former seemed the least trouble, I determined to make the ascension without a car. Mr. Paullin's balloon was large enough to carry him with the car, and all its rigging.

Everything being ready and the balloon filled, at half past twelve o'clock, I proposed to Mr. Paullin that we should start and detach from the earth at the same time. Accordingly, the signal for the start was given, upon which I cut loose and ascended five or six hundred feet before Mr. Paullin's balloon followed. It seems he was apprehensive of the balloons coming in contact if started at the same moment, an event which I had anticipated also, but had no fears of its consequence, on account of the elasticity of such bodies as balloons. When about a mile above the earth, Mr. Paullin's balloon approached so near to mine, being about fifty feet below and twenty or thirty feet to the west of me, that we could easily converse with each other. At the start I was standing on the board which served me for a car, but now I was sitting on it with my feet hanging down. Mr. Paullin hailed me, and said he was afraid his balloon would strike against my feet if he should suffer it to rise higher. It had been announced in the advertisement of the occasion, that the aeronauts would contest which should "stand *highest* in the estimation of the public." Mr. Paullin was of course desirous to mount above me, and his balloon being larger than mine gave him some advantage in that respect. I told him he should not get above me if I could get hold of his balloon, as I was determined to hold it down. It had now got very near my feet, and I was ready to seize it with one hand; the other was required to steady myself with, when it apparently glanced to one side and rose up by mine thirty or forty feet off. As Paullin passed, he cried out "Wise, it looks dangerous to see you sitting on that board." I replied, "Never mind the danger, I'll be after you presently." His balloon now stood about two hundred feet from mine and a little above me. He said, "What do you think of the sight?" I replied, "It is a magnificent one; do you see the Liliputians on the Delaware?" Paullin said, "I feel a breeze coming." His balloon now went up several hundred feet above the height of mine, and as I was intently watching its motion, I observed it suddenly agitated, so much that Paullin lowered himself in his car, for he had been standing up until then. His balloon shrugged up in the net-work, wrinkling it a little above where the net-work diverges from the silk, as though it had been drawn up under the net; and in another moment it shot off southward, immediately over the Delaware, at a velocity of a mile a minute, for a distance of five or six miles down the river. This phenomenon was the more remarkable, because my balloon was not in the least affected by it, though not three hundred feet from Paullin's. It could not have been a general layer or current just above the place occupied by my machine, as I threw off some ballast, and my vessel rose up at least two thousand feet higher, without being affected by it.

This circumstance showed that a rapid current of atmosphere existed which was neither *wide* nor *deep*, as my machine was not far off in a horizontal direction, and crossed the path of Paullin's balloon at a right angle, but a few hundred feet above it, without falling into the rapid current. This is a meteorological fact that is not alluded to, if it is known by, the theorists of that science. There is an inseparable connection between electrical and atmospherical currents. All my experience in passing through these currents traversing each other, has developed this fact.

While I remained almost stationary over the city for half an hour after Paullin's balloon had been drifted off, I perceived that he made several efforts to land; but as often struck the surface of the river, until, by going up again to a considerable height, he was drifted some distance over the river into Jersey, where he effected a dry landing some distance below Woodbury. Half an hour afterwards my descent was made near Red Bank, not much over half the distance from the place of departure, that Paullin's was.

CHAPTER XIII.

Ascension from Lancaster, Pa.—Effect of rough workmanship in balloon machinery—Breaking of valve-spring—Sudden descent—Ascension from Chambersburg, Pa.—Scenery—Singular appearance of South Mountain—Descent—Its magic effect on a cripple—Second ascent from Chambersburg—Rainy day—Sombre appearance of the earth—Passage through the rain clouds—Grand spectacle above the clouds—Harbor in the distance—Illusion—Second stratum of clouds—A heavenly mansion between the two—Its sublimity.

On the 5th of August, 1840, I made an ascension from the county prison yard, in the city of Lancaster. It was a remarkably fine day for an aerial voyage, and a very trifling defect in part of the machinery made it a very brief one, much to my disappointment. As regards the satisfaction of the spectators on this occasion, the following extract from one of the Lancaster newspapers may be considered as a fair exposition:—

"Everything was in complete order, and ready at the time fixed for his departure. He went up in splendid style to an immense height, the balloon moving rapidly upwards in a westerly direction. When about a mile and a half high, the parachutes, each containing a cat, were detached, and both landed safely; the balloon still continuing to ascend.

"At this period of his flight, the aerial vessel floating towards the east, Mr. Wise began to make preparations for a descent, intending to come down within speaking distance of the earth, and then to resume his onward course. The valve at the top of his balloon was opened to permit the gas to escape, and could not be shut again, *the spring having broke*. His descent was, for this reason, extremely rapid, but he landed in safety near Dillerville, a mile or more from the starting point, having been, we should judge, about twenty minutes in the air. There was still in the balloon a sufficient quantity of gas to have re-ascended, could the valve have been closed, but this was not in the power of the aeronaut, as the valve is on the inside of the balloon; and under these circumstances it was inexpedient to attempt the further prosecution of the voyage.

"We have heard but one opinion expressed in relation to this ascension. All concur in saying it was the most gratifying exhibition of the kind which has yet been witnessed by the citizens of Lancaster."

Here then, an aerial voyage was abridged to the distance of a mile or two in length, and a space of time less than twenty minutes, for which the most ample arrangements had been made to have it of long duration and interest, in the way of coming down, holding up a few moments for refreshments, then go up again, and thus make it interesting along the way, as well as at the points of departure and final termination.

Now the practice of this art is a fine one, indeed it may be very properly termed one of the "Fine Arts;" and though its science is not intricate, the mechanical workmanship connected with its practice, requires skill, mathematical exactness, and the highest degree of finish, in order to prosecute it with success. The valve in my balloon requiring some repairs before the occasion just referred to, and thinking that a watchmaker would coil and finish me a wire spring much neater than I had made them myself, I preferred, on this occasion, to have one made by such a mechanic. Accordingly, one was made and inserted in the valve, but the mechanic who made it not observing the precaution of applying a wooden clamp or piece of leather around the wire when screwing it in his vice, thus bruised and weakened it, from which damage the valve-spring broke when worked in the cold region of the atmosphere.

When this happened, the balloon was a mile and a half high, and the force of the air against its lower surface, caused by a rapid descent, made the gas escape with considerable violence from the aperture at the top. Persons who witnessed it from an oblique position, remarked that it threw out a "stream of vapor embellished with the colors of the rainbow." The balloon came down with a rolling, surging motion; and my descent, when near the earth, would have been as hard as when the descents were made by parachute, had not a large quantity of ballast been thrown out when within a few hundred feet of the earth, which checked its velocity to a moderate degree.

During the latter part of the same month I made an ascension from Chambersburg, Pa., of which the most interesting incidents, as related in the journal kept at the time, will be here given :—

Here the balloon shifted from a northerly to an easterly direction, the atmosphere becoming extremely cold. At this time the scene presented a sublime appearance. Around and beneath me the clouds rolled in majestic grandeur, occasionally rising into peaked summits, like volcanoes, and then dissolving down again into the mass below. The valley beneath, where it could be seen, presented the most gorgeous landscape scenery that I ever beheld. After rising about a mile and a half above the clouds, a most magnificent prospect of the country on either side of the mountains that enclose the Cumberland valley, presented itself to my view. Looking over the North Mountain, the eye was greeted by a succession of valleys, rising up out of the earth as it were by magic, to the view, as the balloon rose higher, beautifully variegating the scene. The valleys had a lively color, and appeared like circular pea-green bands laid down between dark-green plats of verdure—

> "Like olive bound with laurels fast,
> Whose verdure must forever last."

Looking over the South Mountain, the scene was entirely different. Here an extensive landscape was presented, circumscribed by rugged and massive clouds, interspersed with numerous roads which looked like so many white lines tortuously spread over its surface, and one which meandered from the base of the mountain upwards, until its further extremity was lost apparently in the clouds above, which formed the horizon of my view, giving to it a magic appearance. This mountain had a very different aspect from the others which were in view. Its dark foliage, interspersed with innumerable whitish looking tortuous lines, being roads and paths, gave it a very unique but beautiful appearance. All this time I continued ascending by a gradual discharge of ballast, until the clouds had sunk so apparently low, as to hover immediately over the surface of the earth. The cold had now become intense, and yet the rays of the sun coming in contact with my person, caused a piercing sensation, like that from needle points, on those parts where it shone. I also suffered a violent pain in the ears, and joints of the jaws, followed by a slight dimness of sight.

At ten minutes before four o'clock, I descended on the farm of *Joshua Kanagy*. This old gentleman was so crippled with rheumatism that he was obliged to walk on crutches, and on these he hobbled towards the place of descent, where the balloon was fastened to an apple tree by the grappling iron, chafing and surging under a brisk breeze that was blowing at the time, and the old gentleman seeing this, and also observing me at the same time in the car, and thinking that his assistance was necessary in the emergency, becoming more excited every jump he made with his crutches, until at length he became so impatient from his slow progress, that he dashed his crutches aside, and ran the balance of the distance between him and the balloon, with as much nimbleness as a hale young man.

When I returned to Chambersburg, which was the same evening of the day the ascension was made, having landed only about twelve miles off, the citizens had already determined to induce me to a repetition of the experiment, being so highly pleased with the one I had just made for them. This came off a few weeks afterwards, the day appointed for it bringing with it rain, which gave an entire new feature to the voyage.

At twenty minutes after three o'clock, the balloon was freed from her moorings, and described a semicircle in her upward course, making a half tour round the town. The borough had a very sombre appearance, caused by the dark shadow which covered the earth—objects, however, were more distinctly visible than in clear weather, and this is always the case when looking down upon the earth from a balloon; where the sun shines on the earth there is more of a quivering haze covering it, than where it is in shadow. The scene below had a melancholy aspect—all nature seemed to be in a state of mourning.

Before I passed the limits of the borough, a parachute containing an animal was dropped, which descended fast and steady, and just as it reached the earth, my aerial ship entered a dense black body of clouds. Ten minutes were consumed in penetrating this dismal ocean of rainy vapor, occasionally meeting with great chasms, ravines and defiles, of different shades of light and darkness. When I emerged from this ocean of clouds a new and wonderfully magnificent scene greeted my eyes. A faint sunshine shed its warmth and lustre over the surface of this vast cloud sea. The balloon rose more rapidly after it got above it. Viewing it from an elevation above the surface I discovered it to present the same shape of the earth beneath; developing mountains and valley, corresponding to those on the earth's surface. The profile of the cloud surface was more depressed than that on the earth, and in the distance of the cloud valley a magnificent sight presented itself. Pyramids and castles, rocks and reefs, icebergs and ships, towers and domes; everything belonging to the grand and magnificent could be seen in this distant harbor; the half obscured sun shedding his mellow light upon it gave it a rich and dazzling lustre. They were really "castles in the air," formed of the clouds. Casting my eyes upwards, I was astonished in beholding another cloud stratum, far above the lower one; it was what is commonly termed a "mackerel sky," the sun faintly shining through it. The balloon seemed to be stationary; the clouds above and below appeared to be quiescent; the air castles in the distance stood to their places; silence reigned supreme; it was solemnly sublime; solitary and alone in a mansion of the skies, my very soul swelled with emotion; I had no companion to pour out my feelings to. Great God, what a scene of grandeur! Such were my thoughts; a reverence for the works of nature; an admiration indescribable. The solemn grandeur—the very stillness that surrounded me seemed to make a sound of praise.

This was a scene such that I never beheld one before or after exactly like it. Two perfect layers of clouds, one not a mile above the earth; the other, about a mile higher; and, between the two, a clear atmosphere, in the midst of which the balloon stood quietly in space. It was, indeed, a strange sight; a meteorological fact which we cannot possibly see or make ourselves acquainted with, without soaring above the surface of the earth. Why is it that the cloud surface corresponded to the earth's surface? What causes two distinct cloud strata, one a mile above the other, in the sky at the same time? The elevated towers or projections that appeared in the distance on the surface of the lower stratum are common to the cumulus cloud, and on this occasion was beautified by the peculiar light cast through the upper stratum. But the distinct regions or vaults of clouds, and the lower one presenting in its upper surface the same irregularities as the earth, are questions for science yet to explain.

I remained in this magnificent heavenly mansion for an hour, and during that time did not move two miles in a horizontal direction, as it was perfectly calm and serene. The day was of a murky character; warm and rainy, and at the time the balloon entered the cloud region it was raining slightly, otherwise it had no peculiar characteristic. The lower stratum of clouds I judged to have been from two to three thousand feet in thickness, as it took seven minutes in passing through. During the descent, and while in the cloud ocean, the sound of my voice produced a very distinct echo.

I made a final descent about five miles from Chambersburg, at thirty-five minutes past four o'clock.

CHAPTER XIV.

Ascent from Danville, Pa.—Appearance of the clouds—Passing over Pottsville—Orwigsburg—Schuylkill Haven—Atmosphere cold over mountainous regions—Appearance of a bread-basket thrown overboard—Its descent seen by persons below—Crossing Reading, its aspect—Pulsatory motion of balloon—Experiments on it—Descent—Warmth when sailing over valleys, &c.

THE next ascension, worthy of note, of which a description will now follow, took place at Danville, Pa., in June, 1841. By reference to my aerial log book of the ascension in question, I find that, at two o'clock thirty-five minutes, I lost sight of Danville, and in a few moments afterwards passed into the clear sunshine above, in which the gas began to expand and cause the balloon to ascend with an increased rapidity. The Susquehanna was now lost to my view by the intervention of clouds, and the country beneath presented one vast wilderness as far as the eye could reach; the atmosphere was extremely cold for the height, over this extensive coal region. The clouds beneath me were sufficiently broken to afford me constantly occurring glimpses of things below; and I never before found them so extremely diversified in their upper surface. On this occasion there were two strata, but not of that distinctive character which were met with in a former voyage. The lower bed was *cumulostratus*, resembling uneven and rugged precipices; the upper was more of a *cirrostratus*, and consisted only of patches here and there, but very high above the lower layer.

At two o'clock forty-five minutes, I crossed the Pottsville road between the Bear Gap and Northumberland road, traveling at the rate of about fifty-five miles per hour. At three o'clock, I crossed Pottsville, and again brought to view the cultivated fields of the husbandman. My altitude was so great that I could not recognize the town until crossing Schuylkill Haven and coming in sight of Orwigsburg. The cold atmosphere became so uncomfortable that it impelled me to descend, but after lowering some distance, I found the valley in which it had been my intention to descend, had been passed, and the chain of Blue Mountains already reached, which required me to seek refuge in the clouds again.

At three o'clock forty minutes, the clouds began to thicken beneath me, so that I could at intervals only see the face of the earth. Perceiving a village which the balloon was about crossing, I threw from the car a new bread basket, which had been placed in it at the time of starting, intended to serve me as a temporary seat should I prolong my voyage. As it fell towards the earth it presented a beautiful appearance to my view; it had not gone far before it assumed a rapid rotary motion, bottom downwards, its upper being the concave side, looking like a beautiful rosette set into a circular motion on its centre. Its descent on the earth, as I was afterwards informed, caused considerable astonishment to several persons who saw it coming down; they not knowing anything of the balloon above them at the time. At 4 o'clock, I passed the town of Reading a little to the west of it. This place had a handsome aspect; the white streets crossing at right angles, and the beautiful spires and domes, white as snow, with their glittering balls and vanes, made the prospect highly interesting.

I found the atmosphere much colder in crossing this mountainous region than it usually is in crossing over a level and cultivated country, at the same height. During this voyage I observed a peculiar motion in the balloon, which had on former occasions drawn some attention from me, but which had not been closely investigated. It is this: When a balloon is sailing along with a steady current, while in equilibrium with the atmosphere, it revolves slowly on its vertical axis. This rotation is not at all times a smoothly continued circulation, but is pulsatory, like the notched wheel in a clock which is actuated by the pendulum. At first I attributed this motion to my breathing, believing the vibration of the lungs sufficient to give a corresponding motion to so delicately balanced a thing as a balloon is when suspended in space. I held my breath as long as I could, and this was done several times; but the pulsations of the balloon were not interrupted by it; on the other hand, they seemed more audible during these experiments. Upon timing these pulsations I found them to be every two and a half seconds, and this seemed to be regular as far as my observations indicated. This left me at a loss to account for this motion, as it seemed not to be caused by my breathing, and did not correspond to the beat of my pulse.

At twenty-five minutes past four o'clock, I descended near the house of Mr. Wm. McIlvain, near Morgantown, about seventy miles from where I started, in a straight line, where I was cordially received by this gentleman and his hospitable lady.

My landing here was caused by mistaking the Downingtown turnpike road for the Pennsylvania railway, which was some eight or ten miles farther to the south. During this voyage I also distinctly felt the difference of temperature in crossing large valleys, where a degree of warmth rose up quite congenial to one's feelings while in a frosty region. This, I presume, arises from a greater quantity of the sun's rays being reflected upward from a valley than from level ground. I forgot to mention that the pulsatory motion of the balloon was not perceptible when it was rising or falling, and is only to be detected when the machine sails a considerable length of time at a great altitude in a steady horizontal direction. Fluctuations of the balloon by rising and falling from any cause soon neutralize this delicate motion.

CHAPTER XV.

Ascent from Lewistown, Pennsylvania—Figure of the town—Mountains and valleys—Their appearance—Juniata river—The narrows—Opinions of their formation—Viewing objects from high isolated positions—Regular order of nature—Ascent from Bellefonte, Pennsylvania—Black balloon—Effect of its color—Current from west to east—Ascent from Wilkesbarre, Pennsylvania—Unfavorable weather—Novel way of going up—Reference to second ascent from Danville—Letting persons up by a rope—Lady went up first—A mania ensued for going up—Profitable business.

A NUMBER of aerial voyages will now be passed over, with extracts only from the journal of some, and details of such when they are new, interesting, and instructive; and such as afford nothing but a repetition of what has been given, will not be noticed at all.

In April, 1842, I made an ascension from Lewistown, Pa. After rising to a considerable altitude, my journal says: At this point, as usual, symptoms of excited electricity were powerfully exhibited by the attractive force of the upper part of the balloon as it passed slowly through the eddy between the upper and lower currents of air. Rising above this point by a circuitous ascent, the country for many miles round became visible. The borough of Lewistown represented a figure like the letter Y. While still ascending, mountain after valley, and valley after mountain sprung up out of the body of the earth as by magic. The sublime workmanship of Him that made the heavens and the earth, burst upon the vision with amazing grandeur, and smiling nature, clad in her vernal garb, looked up toward heaven with a pleasing countenance. For an hour or more, new and beautiful scenes were continually developing themselves. The mountains appeared to range in astonishingly exact parallel semicircles, alternated by the gayer colored valleys between them.

The Juniata River, meandering through the mountains, added much to the beauty of the scene; and my attention was particularly drawn to that portion of the river which passes through the narrows just below Lewistown. The probability of the impression which has obtained with many persons, that the river has, by a sapping, percolating process, worked its way through the mountain, is entirely destroyed when the place is viewed from the point where I passed it. From there it has the appearance of an original formation coeval with the earth's adaptation to water courses; and were it otherwise, it might have worked its way through some distance above, by a shorter, and apparently easier route, or continued seven or eight miles further in the upper valley to where it blends with the one on the other side, into which the river runs.

A calm and deliberate contemplation of the workmanship of the earth, when viewed from a high, isolated position, bringing it in view as a whole, leads the mind to very different suppositions and conclusions, to what it would arrive at when viewing it from its own surface. It may be properly illustrated by the comparison of looking at a rivulet, or the great river that rises from a number of them; or, in viewing a single house, or the whole city. The earth, viewed from a great height, assumes a regularity of order, skill, and arrangement, which cannot fail to strike the mind of an observer with force and admiration.

In May following, I made an ascension from Bellefonte, Pa. The last paragraph of the log-book of that voyage says: I have at present in use a black balloon, which creates a congenial atmosphere around itself in the cold upper regions of the air, from the radiating superiority of that color over a lighter one. It is now beyond a doubt, in my mind established, *that a current from west to east in the atmosphere is constantly in motion* within the height of 12,000 feet above the ocean. Nearly all my trips are strong proofs of this.

Soon after this, one was made from Wilkesbarre, on a very unpropitious day. As it was a novel mode of going up, the account given by the "Wilkesbarre Farmer" may be quoted: "The day was unfavorable; the rain fell in torrents a short time before the aeronaut started, saturating the netting and silk of the balloon, and rendering it, therefore, necessary to dispense with the car. But the storm did not trouble the operator. He said he meant to go up, and he did go. A board about twelve by seven inches, notched at the ends, was attached to the cords, and astride of this Mr. Wise went up most beautifully, cheered by the shouts of the people assembled. He made but a short trip, landing at the foot of the Kingston Mountain, west side of the river, on the farm of Mr. Joshua Pettebone, where every assistance was rendered, and especially by our friend Mr. Seaman, who, having a horse and buggy ready, put off the moment Mr. Wise did, and brought him and his balloon safely back in two hours from the start."

A number of ascensions of which the accounts have been omitted, had nothing interestingly new or instructive connected with them, excepting, perhaps, the second one made from Danville, on which occasion I landed near to that place, and after coming down, offered to let some persons go up the length of a rope, which the bystanders every one of them refused to accept. At this time a rustic looking young country girl came along from town, where she had been at the balloon ascension, and was invited by me to take a seat in the car, which she did, and was soon let up two or three hundred feet, much to the satisfaction of herself and amusement of the bystanders. After hauling the machine down again and handing the young lady out of the car, I prevailed on a trumpeter, who was now standing by with his instrument, to make a similar adventure, which he did, and when up gave a few blasts with his trumpet, which acted like magic in bringing the people across the Susquehanna bridge, which was between the place where the balloon now was and the town. Upon this a perfect mania ensued among them to get into the car and ascend the length of the rope, which was four hundred feet long; some going the whole length, others not aspiring to more than half, and some even less. Having first charged nothing, the business got too pressing, upon which a quarter of a dollar a trip was levied, and this not abating the pressure of business, it was raised to half a dollar per ride, at which it was kept up until I had realized eighty dollars, and was then only compelled to close the "fun" on account of the immense throng which had surrounded the balloon making further operations in this way impracticable. Some paid for two and even three trips up before they left the car.

CHAPTER XVI.

Ascension from York, Pa.—Two failures had been made there by Mr. Parker—Its effect on the people—The day for mine was unfavorable—The populace would not have it put off—My predicament—Reason, and compromise—Decision—People reasonable—"York Gazette" account of it—The start—Scenery, and clouds—Tore the balloon in the clouds—Consequences—Scene above the clouds—Phenomenon—Thunderstorm—Brilliant image on clouds—Sensations—Reflections—Balloon speed—Descent—Another ascent provided for on my return—Extracts from "York Gazette."

While I was remaining at Wilkesbarre, a very flattering invitation from Messrs. Glossbrenner and Morris, of York, Pa., who were then on a visit to the Wyoming Valley, was tendered me, to come to their borough and make an ascension, which I cheerfully accepted. The late Mr. Mills, a very successful aeronaut, had made a very satisfactory ascension from York the summer previous, and died there while making preparations for a second.

A Mr. Parker, who professed to be an aeronaut, volunteered to make the ascension which Mr. Mills had made preparations for, but he failed in getting up with the balloon; and shortly afterwards tried and failed again, which exasperated the populace to such a degree that it became necessary for Mr. Parker's safety, to put him in the hands of the sheriff of the county. This double failure had a tendency to make the people of that county rather suspiciously inclined towards balloon experiments. Many of the country people believed it to be a plotting humbug in order to delude them into the town; others doubted the sincerity of balloonist's intentions of going up, looking at it as a dangerous business. These circumstances made it a delicate matter for me, in case I should be so unfortunate as to fail in getting up, and although I had now acquired a reputation as a "successful aeronaut," it only made it worse for me, in the event of any accident that might foil me in making the ascension according to announcement. The balloon which I had then in use was not throughout of strong material, being made of black silk, a part of which being of a different texture from the other, was very mellow. However, an ascension was determined on, let the consequences come as they would. The last Saturday in August, 1842, was appointed for the experiment; and as it was one fraught with interest on various accounts, a detailed description of it will be interesting.

As fate would have it, the day turned out with boisterous and stormy weather. The atmosphere was continually charged with black thunder clouds, and incessant squalls of wind alternated the strong gale from the west which blew all day. The people, no ways daunted from the last summer's failures, poured into town in a continuous stream. Twelve o'clock came, the time for commencing the inflation, but it brought no hopes of success in case it should be attempted. The people began to gather round the enclosed arena, which occupied a large open common on the outskirt of the town, and frequent and determined were the threats from their lips of what would be done in case they should be "humbugged again." As the time passed on, my friends also became uneasy, they thinking I was rather timid. Thus things went on until near two o'clock, the time announced for starting on the voyage, and things were coming to a crisis; already from eight to ten thousand persons had assembled on the common, and more than threat had already commenced to develop itself in some angry countenances. The last consolatory words from my particular friends were, "You are in danger of violence." I had remonstrated against their advice of going on, as I contended that a failure would be more fatal to all concerned than a postponement to a better day. But they told me a postponement was out of the question under the circumstances. Now, as I had no confidence in the strength of my balloon holding out under such squalls, and as a postponement would not be tolerated, I determined to reason with the people, and at once went to the outside of the arena, mounted a table, beckoned the immense crowd to listen to me for a minute, which, after one very refractory individual had been quieted, was granted.

I made a brief statement of facts and circumstances, as connected with the occasion, and mentioned to them that God made the weather while I professed only to make ascensions, and then put the question to them whether I should go on under the circumstances, or postpone it to a better day, with the proviso, however, that they would buy tickets under the risk of a failure, and that they were *not* to mob me, nor suffer me to be mobbed, nor ask their money back if I should fail on account of the weather. It was unanimously agreed that I should go on, with a loud promise, "We will stand by you through thick and thin." Just at this moment a gentleman stepped up, who I learned was Doctor Ness, and in a proper and terse manner substantiated my explanations.

In another moment the gas retorts were in active operation, as no time was to be lost in getting the balloon inflated. This process had not gone on long before every one present began to realize the truth of my remarks.

The balloon stood the blast, and at four o'clock was sufficiently inflated to prepare her for the flight. As the inflation and start are sensibly and graphically described by the "York Gazette," its article relative to this occasion may be properly quoted: "Mr. John Wise, the celebrated American aeronaut, made from an enclosure at this place on Saturday last, one of the most beautiful balloon ascensions ever witnessed in Pennsylvania, or probably in the Union. An immense crowd was assembled to witness the ascension; the number is variously estimated at from six to ten thousand persons.

"There was quite a strong breeze early in the morning, and it continued to blow up to, and beyond the hour at which the inflation was to have commenced. This occasioned some delay, as it is exceedingly difficult to inflate a balloon in a strong wind, and in four cases out of five, when it is attempted, the balloon is torn during the process. At about two o'clock, though the wind had not entirely ceased, Mr. Wise, anxious to gratify the thousands who had assembled, many of them from a considerable distance, to witness an ascension, determined, at the risk of destroying his new and costly balloon, to commence the inflation. Then the danger became evident to all; for, although the wind was very slight, yet as soon as the balloon had been swelled by the gas to a height of six or eight feet so as to present any surface to the wind, it became as fractious as a drunken Mohawk. Mr. Wise found it necessary to have the assistance of about a dozen of his friends, who were all kept quite busy in preventing it from tearing itself to pieces.

"The excellent preparatory arrangements, however, of Mr. Wise, and his unruffled temper and systematic method of conducting the process, overcame all the difficulties; and at about four o'clock he attached his car to its aerial steed, entered it as coolly as though about to seat himself for a ride upon an "ambling pad pony," and was launched, amid the cheers and shouts of congregated thousands, into the air.

"He cleared the enclosure by about ten feet, and sank a few feet immediately on the outside, but by throwing out a portion of his ballast he was enabled to rise sufficiently as he moved off beautifully in an easterly direction. He seemed, to those who saw him from the point at which he started, to rise as he receded, keeping on in one direction until lost to their view behind a cloud about five miles distant.

"We never saw a more gratified multitude than were assembled on this occasion. All seemed delighted, and to be at a loss for words to express their admiration of the sight presented by the daring aeronaut as he replied from his seemingly perilous height by a graceful wave of his hat to the cheers that continued to greet him as long as his features could be distinguished."

Narrative of the journal:—

At fifteen minutes past four o'clock, the aerial ship United States was released from her moorings under a heavy blow from the south-west, gliding swiftly near the surface of the earth until her ascending power was increased by a discharge of about forty pounds of ballast; when at a distance of several miles from the common, the ascent became very rapid. At eight minutes after the start I passed through some filmy clouds, going nearly parallel with the railroad all the time, and in a few minutes overtook the locomotive, which had started about fifteen minutes before the balloon did. At four o'clock thirty minutes, I commenced penetrating a dense stratum of clouds, after having enjoyed a magnificent view of the country for thirty miles round, bringing into view over fifty towns and villages, innumerable streams of water, with the beautiful Susquehanna in their midst. On entering the clouds the atmosphere grew cold; but after passing through the lower stratum, and getting into the shadow of cloud patches far above the lower layer, the cold became so intense as to convert my breath freely into hoar-frost. I did not suffer much from this cold atmosphere, as the excitement of the day had supplied me with a fervor that lasted through the whole voyage, and it would be a senseless being indeed that could pass through such scenes without excitement. While passing through the clouds, the balloon rising at a furious rate, I attempted to open the valve to discharge gas, but was prevented by the lower part of the balloon having so closely taken the valve rope into a fold, it being flaccid, that it became impossible to work the rope through. This would of course become relieved by the expansion of the gas, which would unfold it as it would rise into a rarer region of the atmosphere; but as the balloon was mounting so rapidly, and the air quite cold enough already, I was determined to arrest its upward progress by a violent tug of the valve rope, which succeeded in releasing it, and bringing with it a strip of the balloon five feet long and seven inches wide at one end, tapering to a point at the other. This piece came clear out of the balloon and dropped down by the car, so near that I reached for it as it fell past. Being from the lower side of the balloon, it would cause no serious consequences, unless in case of a rapid descent it might by the rush of air against it cause it to slit upwards, and open the whole side of the balloon, an accident which would not endanger my life. After having risen some distance above the clouds into a clear sunshine, the temperature became more congenial, and a most brilliant cloud scene lay beneath me; a spacious snow-white ✓

concavity, with here and there a pyramidical projection jutting from the common surface. To the south-east a violent ebullition in the cloud ocean indicated the formation of a thunder storm, which soon developed itself in uprising cloud columns discharging electric flashes and *rattling* thunder. The shadow of the balloon was visible on the surface of the clouds below, and after getting so high that it became completely distended, I discharged gas from the valve, while it was at the same time copiously discharging from the hole which had been made in tearing out the piece with the valve rope. The gas escaping from the rent below assumed a white milky color. Looking down upon the clouds at this time, a most beautiful phenomenon presented itself, like that on the disk of a camera-obscura. Around the dark shadow of the balloon there appeared a bright blue ring, and on the outside of this ring surrounding it, there blazed out a brilliant halo of fiery red. This splendid image increased and diminished in size as the balloon was lowered or elevated above the cloud stratum. I gazed on it until my eyes became dazzled and painfully affected by its brilliancy, and I could not refrain from ejaculating over the transcendent privilege of viewing such celestial grandeur; for, at this time, a combination of scenes and circumstances never before witnessed at one time, conspired to make the scene grand beyond the power of description.

When my aerial ship had passed over the thunderstorm and got some distance ahead of it, I gradually descended, reaching the cloud ocean in five or six minutes; and when in this cold misty sea, my feelings became painfully depressed; the transition from so beautiful a haven assisted in no small degree, in producing the gloomy and morbid sensations that followed. I really felt like an expelled intruder, who had been driven from a usurpation. As soon as I got through this gloomy abode of the clouds, and in view of as beautiful a prospect as the eye ever gazed on, the fertile landscape of Lancaster county, my spirits became somewhat revived, besides, I was now viewing the place of my birth, the town, the street, the pleasure grounds of my youthful days, dreams, enchantments, realities, doubts, all seemed to have held their sway within the last hour. Such voyages are strange and exciting things.

After sailing over the city of Lancaster, my course was parallel with the Pennsylvania rail-road, down which a locomotive was plying with a train of cars, which was soon overtaken and passed, showing that steam cannot compete with balloon speed, when they both move in the same direction. At thirteen minutes past five o'clock, I landed on the farm of Wm. Hiester, Esq., near the village of Newholland, about thirty-nine miles from the starting point, being at the rate of fifty miles per hour in the horizontal direction.

When I returned to York, the citizens had already contributed an amount considerably over and above the sum demanded by me as an inducement to make a balloon ascension, for another balloon voyage from their place.

This ascension took place on the twentieth of August following, on which occasion the day turned out to be of fine clear weather, and a very calm atmosphere. The "York Gazette," in noticing this voyage, indulges in the following remarks: "We considered his thirty-sixth ascension the *ne plus ultra* in grandeur, but it was far exceeded by the last. Mr. Wise, on this occasion, was favored by almost a perfect calm; and having cut his cord, he ascended almost perpendicularly to a height of four or five thousand feet. He receded from the spectators so slowly that they could distinguish his features for about three minutes, and his form five or six minutes, after his departure. In all this time he was receiving and gracefully acknowledging the reiterated and thundering peals of applause from delighted thousands. We never witnessed a crowd so completely carried away by their feeling of unmixed gratification. They did not seem to be able to find words commensurate with their enjoyment; but every moment, shouts, spontaneous and simultaneous, would be sent up to the car of the aeronaut from countless throats, and the calm and collected occupant of the apparently frail vessel could be seen, with his head uncovered, returning the salutations as they reached him, from a height so tremendous, that his form appeared to be reduced to the proportions only heard of in fairy tales.

"It is safe to predict, that not one of all the vast crowd assembled on Saturday, will ever again witness on earth a spectacle so unutterably grand and sublime as that presented by Mr. Wise, in leaving the earth on his thirty-seventh aerial voyage."

In lieu of the account from my log-book, the above has been quoted. The voyage being over nearly the same course as the one preceding it, and nothing of a new character having occurred in its progress, it would consist of a mere repetition of what has been said. The remarks of the "Gazette," however, go to show what enthusiasm prevailed at these exhibitions, when they were conducted with system and decorum. The editor of the "Gazette" is a close observer of the progress of the age, and at this time paid particular attention to the practice and philosophy of aeronautics. The following is taken from his paper of that period:—

"Curious Appearance of the Earth.—Clayton recently made a successful ascension in a balloon from Columbus, Ohio. Among the remarks in his journal of the aerial trip, we were struck by the following:—

"From the questions that I am frequently asked, an idea seems to exist with many that aeronauts lose sight of the earth when at a great height. This is a mistake; they never do, except when clouds intervene or night appears. On the contrary, the earth is always like an immense concave map, painted different colors, which designate not the different townships or counties, as maps generally do, but the various products of the soil.

"'That the earth, which, in reality is convex, should appear to the aeronaut to be concave, may at first seem strange to many, but a moment's reflection will render it clear. His horizon is frequently upwards of a hundred miles from him. Draw a right angled triangle, and make the base line fifty or sixty times as long as the perpendicular, the hypothenuse and base will then be nearly in the same line. The horizon appears to the aeronaut to be on a level with the car of the balloon; but the part of the earth directly underneath him seems at a great distance from him, consequently the whole surface of his scene appears concave.'

"Mr. Wise, in a very interesting lecture on the subject of aerostation delivered by him in York, on Wednesday evening last, also mentioned the apparent concavity of the earth, when seen by the aeronaut from his car at great altitudes. He also spoke of the entire absence of vertigo or giddiness when at the loftiest point in the air he has yet reached in his car. He states that he is as susceptible as others, perhaps peculiarly so, of the giddiness experienced so generally on ascending any considerable height; and we chanced to see him under the influence of this unpleasant sensation, a few months ago, as we sat together upon the highest point of 'Prospect Rock,' near Wilkesbarre, a point from which we could look down upon the lovely valley of Wyoming in its whole length and breadth. On that occasion we expressed surprise that *he*, accustomed as he was to ascend for miles into the air, should be rendered giddy by a situation that affected us so but slightly. He then made a remark which we recollected on hearing it, to have seen published somewhere, that the sensation is lost to the aeronaut *as soon as he becomes entirely separated from the earth.* While a single cord remains to attach him to the earth, his steadiness may be seriously affected; but when the last connection is severed he is not disturbed by a height that would under ordinary circumstances stagger the most daring, and send an iron nerved man reeling from his elevation."

CHAPTER XVII.

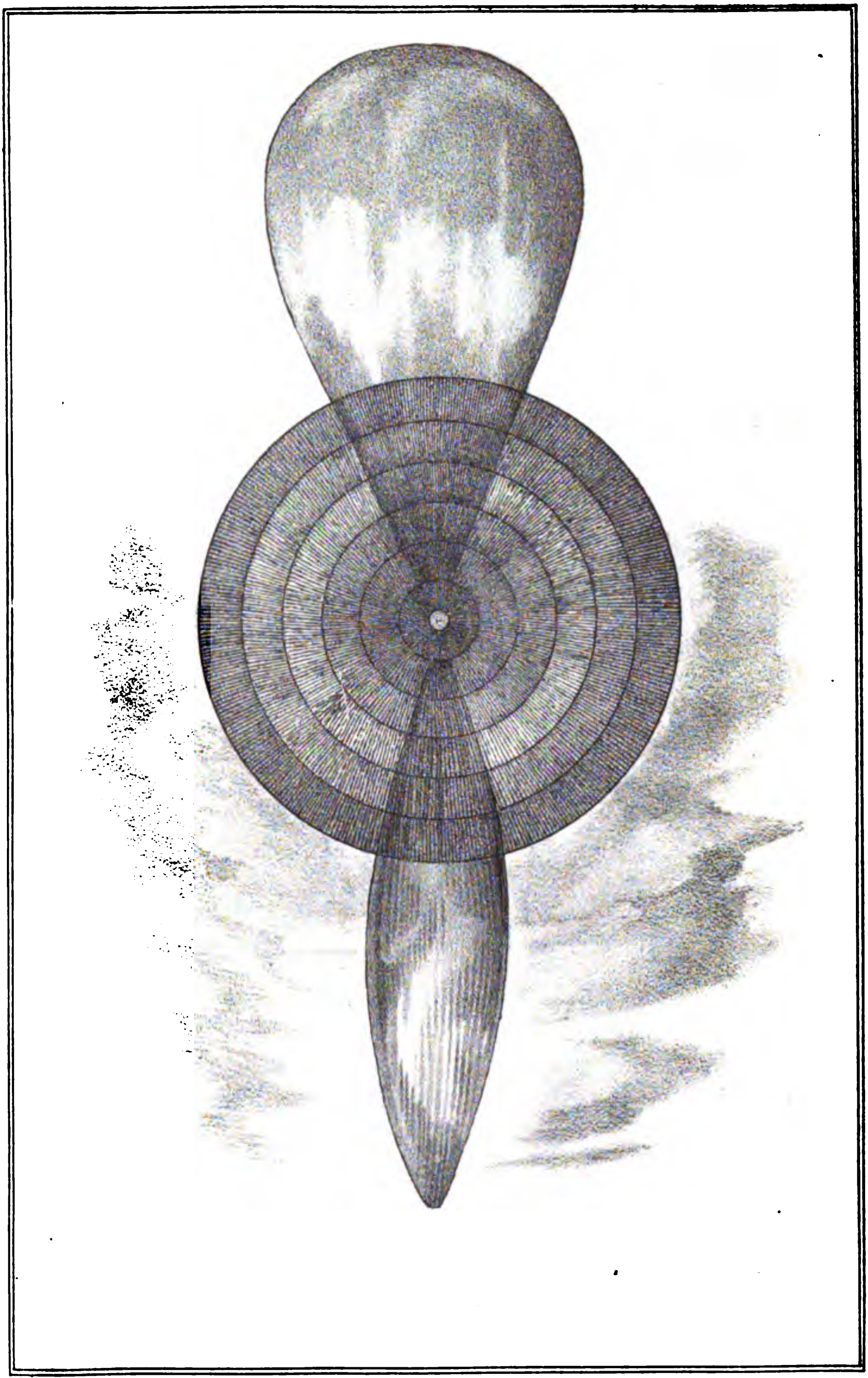
Ascent from Gettysburg, Pennsylvania—Experiments on the spiral ascent of bodies—Refraction of light—Parhelion—Its effects—Waving motion like aurora borealis—Experiments on it—Peculiar brilliancy of a mountain scene—Peculiarity of atmosphere and clouds—Descent—Second ascent from Gettysburg—Made by an amateur—Historical description of it—Humorously but graphically written — Perilous descent of the amateur.

In September of 1842, I made an ascension from Gettysburg, Pennsylvania, of which the following account was written at the time. During the preparatory arrangements for my thirty-eighth aerial voyage, made from Gettysburg on the 10th inst., it was suggested by Professor Jacobs, of Pennsylvania College, in company with several other scientific gentlemen, to make some experiments upon the spiral ascent of the small balloons that were to be sent off as pilots. Having noticed that they revolved on their vertical axes when ascending, in a direction opposite to that of the revolutions of the hands of a clock lying with its face upwards, Professor Jacobs proposed that the remaining two pilots should be started with a rotary motion, opposite to that which they assumed when let off uninfluenced. Accordingly, they were started with considerable impetus in that way, but that motion subsided in a very short time, and the other, or contrary motion, took effect, and continued as long as they could be seen, which was until they passed into the clouds. The large balloon also revolved in the same way on this occasion; and in pursuing these experiments, by throwing down when above the clouds, substances of different kinds and shapes, they all fell with the same rotary motion. The atmosphere at the time of starting on my voyage, twelve minutes before 4 o'clock, was perfectly calm, and the upper heaven was completely partitioned off from the earth by a thin layer of clouds. The height from the earth to the clouds was 3900 feet by measurement. The atmosphere became slightly colder as I ascended higher until entering the clouds, where it was somewhat warmer than just beneath them; and when entirely above them the sun's rays had a powerful effect upon my body and upon the balloon, as its accelerated upward motion quickly told.

The phenomenon of refracted light which had so much interested me on a former voyage, made its appearance again upon the thin layer of clouds beneath, and my particular attention was now directed to its operation. The *parhelion* was this time more perfectly formed in regular prismatic rings, the cloud stratum being thin on which it was refracted, and consequently did not reflect so much dazzling light as before, when it was thicker. It appeared too on this occasion that the cause assigned to its production on a former voyage, was not altogether essential, being a profuse escape of gas, as on this it originated from the mere diffusion of gas round the balloon. The air being very calm, suffered the balloon to remain a longer time in the same spot, and consequently a rarer and more refractory medium would be formed around it, enhanced by the radiating power of its color (black).

The shadow of the balloon was well defined on the clouds, and the prismatic colors forming rings around it were brilliant; there appeared also another, but dim shadow, immediately opposite the main one, much narrower and fainter, and they each crossed or rather laid on the prismatic rings, as represented in the engraving, reaching from near the centre to some distance over the outer ring.

The smaller shadow was continually expanding and contracting, sometimes getting nearly as wide as the main one, and then contracting into a mere line again, resembling in its action the *waving* motion of the aurora borealis. This motion I thought might have been caused by the different degrees of thickness of the cloud stratum on which it was formed, as also the difference of distance between the balloon and the surface on which it acted, as the clouds were moving along, while the air ship was apparently becalmed; this would continually change the condition of space between the object and its shadow, as it would the density of the substance that formed its screen. The parhelion and shadows varied in size as the balloon ascended or descended, which I caused it to do several times to a degree of not less than six to eight hundred feet. What appeared most remarkable to me, was the appearance of this phenomenon after the balloon had descended between the clouds and the earth. While coming down over an open space in the clouds, I noticed the parhelion disappear in it, and in another moment discovered it on the green surface below, being a woods, not with its regular rings, but in a red fiery halo blending all the colors in it, and when it passed from the woods it was still perceptible on the green fields, but more diffuse than when on the woods. When I got below the cloud stratum the balloon moved slowly in a horizontal direction, at the rate of about a mile in eight minutes, and whenever it would pass an opening in the clouds, so that it fell in the sun's rays, the fiery



P. S. Duval's Steam lith. Press.

PARHELION.

halo made its appearance at the corresponding point on the surface of the earth. The appearance of the phenomenon on the earth's surface was much like the reflected glare in the sky, of a night, during a conflagration.

During the early part of the voyage, there appeared a magnificent sight in the west. No clouds being in that direction, at a point some miles off, a portion of the mountain region was receiving a flood of light from the sun, which gave it a peculiar lustre, such as I had never seen before, though it has often happened that the sun was shining only in spots upon the earth which were visible to me. While in the clouds I noticed them to have a more milky looking aspect than is usually the case; and it was noticed by the spectators below, who informed me of it afterwards, and they further remarked, that "the balloon looked white," the moment of its submersion in the clouds, until it vanished from their sight. After I had been above the clouds for more than half an hour, I came down once so low that the spectators from the town saw it for a moment, and they informed me that it was not far from the point where it had entered them at the start, making it evident that the balloon was almost totally becalmed while above the cloud stratum. It was a peculiar state of the atmosphere throughout.

After remaining in the atmosphere eight minutes less than one hour, the greatest part of the time above the clouds, I came down to terra-firma, two and a half miles from the point where I had started.

These interesting facts were observed and noted with as much precision and deliberation as if they had been observed from my private chamber, and they were submitted to my friend, Professor Jacobs, who had been with me during the inflation, engaged in observing the experiments made before the start, and it was he that took the altitude of the clouds.

The people of Gettysburg were so much pleased and interested with this ascension, that they determined to have the experiment repeated in a few weeks afterwards. In the mean time, by their particular request, I entertained them with a public lecture on the subject of aeronautics, in the court house. Touching strongly upon the simplicity of the science during this lecture, and portraying the magnificent grandeur of its developments to the practitioner of aeronautics, it inspired some of the hearers with an indescribable desire of its enjoyments, but only one of them was willing to believe implicitly what I had said of its *non* danger as practiced by me. This individual was Colonel John M'Clellan, of Gettysburg. On the following day he made me a proposition to take him along on the contemplated voyage to be made in a few days from that place. The time being too short to make the extra arrangements necessary to carry another individual besides myself, I mentioned it to the colonel, and at the same time informed him that if he did not wish to wait for another opportunity, he might take my place on the Saturday following for half the price of what I had asked to take him with me, which would make it but fifty dollars instead of a hundred. He answered that he thought he would take me up at that. I did not believe, however, that he would go by himself, inasmuch as we had already spoken of making it suit to take him up at Emmetsburgh. When the day came for the ascension, the colonel made his appearance about half an hour before the time announced for starting, gave me the fifty dollars, security for the safe return of the balloon, and took some hasty instructions for the management of the machine while aloft, and also to effect a systematic descent. These were as promptly given him, and after this no persuasion, neither from his brothers and sisters, nor from me, would induce him to relinquish his desire for the present; and so I sent him up, confident that he would come down safe if he did not give up the ship, and my last injunction to him was, "Stick to the ship." He went up in gallant style, throwing out ballast until he mounted to an altitude of about two miles, and then passed out of sight. He went about twenty-five miles, landing a few miles west of York, Pa., and was from thence escorted into York by some dozen acquaintances, who saw the balloon descending, and finding with it to their great astonishment, Colonel John M'Clellan, of Gettysburg, instead of the individual with whom they had an understanding to meet, if he would come down near York. Indeed, I regretted that I had to forego the pleasure of paying my York friends a visit via the clouds, when I saw the favorableness of the breeze, and the pertinacity of the colonel's intentions.

When arrived at York and surrounded by a host of friends, the colonel was requested to give a detailed verbal description of his adventure, which he did, and with a great deal of accuracy, showing, that before he commenced coming down, he had been a deliberate observer. Mr. Glossbrenner, editor of the "York Gazette," being present, took notes and made a publication of it in his next paper. It is written with some humor, but, nevertheless, with a graphicness and accuracy in regard to the appearance of things, that could only come through the suggestions of an actual observer. This description has already become a historical fact, and is as follows:—

"BALLOONING EXTRAORDINARY.

"A daring feat was accomplished on Saturday last, by a citizen of our neighboring town of Gettysburg. Mr. John Wise, *the*

American aeronaut, *par excellence*, had announced his intention to make his thirty-ninth balloon ascension on that day, from an enclosure in Gettysburg; and with his usual punctuality, was ready on the day and hour promised. His balloon was inflated; his ballast, grappling-iron, &c., duly stowed, and he was about to step into the basket. At that moment, Mr. John M'Clellan, a young gentleman of Gettysburg, inquired of Mr. Wise whether it would not be possible for *two* persons to ascend with the power then in the balloon. On receiving a negative reply, Mr. M'Clellan seemed much disappointed; said he was determined to have a ride, and inquired the price at which Mr. Wise would permit him to make the voyage alone. 'One hundred dollars, sir,' said Mr. Wise, who did not appear to consider the inquirer to be in earnest. 'I will give you fifty dollars!' 'Agreed—fork over!' The joke was 'carried on,' and the *cream* of it was soon transferred to the pocket of the aeronaut, and his substitute was snugly seated in the car, vociferating his direction to 'cut loose!' Mr. Wise thought that matters had now gone far enough, and requested his customer to get out, as the time had arrived at which he had promised to be off. But he refused to do so, and insisted that he had regularly hired and paid for a passage 'in this boat,' and go he would. As Barney O'Reardon said to the man in the moon, when the latter respectable personage told him to 'lave his hould;' 'the more he bid him, the more he wouldn't!'

"Mr. Wise then let up the balloon a short distance by a rope, thinking, probably, that as there was considerable wind, and the air horse consequently turbulent, that his *substitute* would have his courage cooled, and 'give in.' But this was no go; and thinking that he had as good a start as ever he would have, Mr. M'Clellan cut the rope, *and was off!* After he found that it was the *determination* of Mr. M'Clellan to go, Mr. Wise had but time to give him a few hasty and imperfect instructions in regard to the management of the balloon, and in a few minutes the daring amateur aeronaut had ascended to a height of about two miles. Here he struck a current of air which bore directly towards York. He says that the earth receded from him very rapidly after he had thrown a bag or two of sand upon it; that Gettysburg passed off towards Hagerstown, and that he saw Carlisle, Hanover, Abbottstown, Oxford, and Berlin strolling about; and that soon after, just ahead of him, he saw old York coming full tilt up the turnpike toward him, apparently taking an afternoon walk to Gettysburg. Having determined to stop at York, and fearing, from the remarkable speed at which our usually staid and sober town was traveling, that she would soon *pass under his balloon*, and give him the slip, he pulled the string attached to the safety valve, in order to let off a portion of gas. This valve is so constructed, that when a rope attached to it is pulled, the valve opens to the interior and again closes by the force of a spring when the rope is let go. Unfortunately, however, the inexperienced aeronaut pulled too violently at the valve rope, tore the valve door completely off its hinges, and brought it down into the car. When this occurred he was more than a mile high, and he immediately, and with fearful rapidity descended, or rather *fell* to the earth. When the valve door came off, the gas, of course, escaped rapidly, but the balloon caught sufficient air to form a parachute, by which the fall was moderated, and we are happy to say that the voyager reached the earth about five miles from York entirely uninjured. He says that as soon as the valve door came down upon him, he knew that something had 'broke loose;' and just then remembering that Mr. Wise had told him to be on his guard when he descended and throw out his grappling-iron, he was preparing to get at it among the numerous things in the basket, 'when the earth *bounced up* against the bottom of the car!'

"When first seen from York, the balloon was about thirteen miles off, nearly due west. It appeared to be approaching directly toward our town, until the valve was pulled and it had fallen considerably. As it fell, it seemed to find a current that bore it rapidly toward the north. The spot at which it landed is about north-west of our borough.

"The escape of the gas was distinctly seen from York; and as the balloon neared the earth it had lost its rotundity, and appeared to the gazers here to come down *heavily*, like a wet sheet."

This was another proof of the efficacy of atmospheric resistance in bringing large surfaces falling through it, down with a moderate velocity.

CHAPTER XVIII.

Balloon campaign of 1843—Transatlantic project—Ascent from Carlisle, Pa.—Rev. Mr. Thorn's communication—Account from aerial log-book —"Beautiful and interesting spectacle"—Mr. Forney's description—Landing at Lancaster—Entry in the city—Reascension from Centre Square—Descent, &c.

In the spring of 1843, the inhabitants of Carlisle, Pa., invited me to make an ascension from their borough. During the winter which had just passed, I had consulted some gentlemen of the city of Philadelphia, upon getting up a project of crossing the Atlantic with a balloon. From the facts and deductions laid before them, they were willing to promote the enterprise in case I would undertake it. This stimulated my exertions to a furtherance of this project, and I had determined to spend all my time and talent to its consummation. But as soon as these gentlemen saw that my whole energy was directed in that way, they began to evince conscientious scruples as to the responsibility that would fall on them, in case of my being "sacrificed to my too ardent convictions" of success, and so my fond hope was doomed to wait a while longer. I determined, however, to try Congress at its next session, thinking that I could give them facts sufficient to induce them to appropriate so trifling a sum as it would require, to consummate this first step, in an art that promised so much benefit to the human family. As I could now do no better, I concluded to make a summer's campaign of aerial voyages, and accordingly went on to Carlisle to begin; intending at the same time to keep in view, and embrace every opportunity, that would tend to enable me to carry out this desirable project.

The ascension from Carlisle was announced to come off the third Saturday in May, 1843. It turned out to be a very interesting one, as I had promised my friends in Lancaster city to visit them via the *atmospheric current that always blows from west to east* in the higher regions of the air.

Rev. Mr. Thorn, of Carlisle, a gentleman of the highest integrity, and well trained scientific mind, took a lively interest in the experiment, and is the author of the following eloquent description of the first balloon ascension made from that place.

"The balloon ascension advertised by Mr. Wise, the celebrated aeronaut of forty aerostations, took place in this borough on Saturday last. The day was preceded by clouds and gusts of wind, ensued by rain, accompanied with the most vivid flashes of lightning and heaviest peals of thunder with which we have been visited for a length of time; and indeed, so marked, according to human calculation, was the appearance of a continuance of such weather, so subversive to successful exhibitions of this kind, that many persons imagined the feat would be abandoned or deferred. At about nine o'clock in the forenoon, however, the clouds began to disperse, and the sun, that bright orb of day, displayed his Creator's power, by dispelling the mists and density of the atmosphere in which we had been enveloped, and substituted in its stead, the most clear and effulgent sky we ever beheld. At ten o'clock, hundreds of persons from various parts of the adjoining country, began to rush into our town, and to collect in various groups in our principal streets, which, together with the appearance and drill of Captain Washington's superior company of U. S. mounted Artillery with their cannon and accoutrements, gave an enlivening and imposing scene to our borough. Soon after twelve o'clock, the process of inflation of the balloon was commenced; at two o'clock, preparatory arrangements were made by Mr. Wise for his ascent, which, in half an hour, were ready. Previous to it, however, he with great politeness came forward, and in a very respectful manner, gave an invitation to the ladies composing the assemblage within the inclosure, to approach within the limits prescribed for them, that they might have a more clear and distinct view of the interesting scene they had convened to witness—which they accepted. He then proceeded to an interchange of salutations with the friends and acquaintances he observed around him—bade Mrs. Wise and his son, a promising lad of six years of age, an affectionate farewell; but with the entire confidence that the separation would be temporary—an absence of a few hours only. After which, making a general obeisance to all around, he stepped into, what appeared to us, a little brittle and insecure basket, with a fearless, unfaltering and dignified mien. He then examined with composure, the various articles which had been deposited therein, apparently with a view to adjust their balance, and to ascertain whether anything, which might be required on his voyage, had by any omission been left behind.—Perceiving, to use a familiar phrase, 'that all was right,' and that the most intense interest was depicted in the countenance of every beholder, he gradually, but beautifully and majestically ascended, amid the cheers, plaudits and acclamations of the surrounding multitude, and the transporting strains of a fine band of music, discoursing an inspiring tune. Thus did the successful aeriel navigator depart from the scenes of terra firma, to indulge from his cloud skirt height in fancy's visions on the baseless fabrics 'of the world's ideal,' and of the skies unknown.

"The balloon arose, diverging but little from the direct line with which it set out; and the aeronaut continued several hundred yards above the spectators for a considerable time, waving his hat in recognition of the cheers which were complimenting him from below. The atmosphere calm and the sky serene, he remained in sight nearly an hour; some viewing him with telescopes, while he could no longer be seen with the naked eye. The following memorandum, being a description of the voyage, and written by Mr. Wise during his voyage, will doubtless be read with absorbing interest by every one. An incident related by him, relative to his descent at Lancaster, tends to increase the confidence that is already reposed in him as a scientific aeronaut, and of the management and direction he is capable of giving to his balloon. He had informed his friends and acquaintances at

Lancaster, that it was his intention to land there on this occasion, as it lay *east* from Carlisle—a direction, he says, he can always attain—and visit his domicil. The citizens being thus apprised of his design, were awaiting his arrival, and when he came within a distance of being heard, they called aloud to him and said, 'Wise, you have redeemed your pledge!'

"Such being the favorable circumstances under which this experiment was made and ended, permit me to observe, that the remark is occasionally made in opposition to the science of aeronautics, that inventions of this kind are not to be encouraged or witnessed, because, through the perversion of men, they occasionally lead to vain and pernicious amusements. Admitting this to be the case, is this a reason why it should be decried and condemned any more than many other useful arts? But the objection usually, if not invariably, arises from persons of narrow minds and contracted views, relative to the progress of the human mind in the enlightening and renovation of mankind. Air balloons are destined ere long to be brought to such a state of perfection, and be made capable of raising and carrying so much weight, as to be applied to highly useful and important purposes. Let encouragement be given to these experiments; let 'the soul of fire, the invention ever new,' the 'lively cheer of vigor born,' and the incitement to continual exertion, both mental and bodily, by the emulation of ingenious men, be patronized sufficient to enable them to conduct their operations on an extensive scale, and time and experience will make them subservient to numerous philosophical uses, and bring to light many things which pass in the atmosphere; such as the formation of rain, of thunderstorms, of vapors, hail, snow, comets, meteors in general; and which, for the want of a method of ascending into it, cannot be known with precision.

"They may tend also to the general improvement and amelioration of mankind, in effecting the designs of a beneficent Providence, to a lost and ruined world. Is it not possible, nay, is it not probable, that ere long, if suitable inducements be held out to the promoters of this science, a contrivance or means of conducting expeditions through the atmosphere in a horizontal direction will be discovered, by making these machines subject to the helm of the aeronaut? And if so, may they not be converted to purposes of mercy; by exploring countries hitherto inaccessible; bringing together parts of the earth which are now estranged to each other, and spreading knowledge to all mankind? Many are the good and sensible men, who are of the opinion that every part of the habitable globe must yet be explored, and its inhabitants visited with the salvation of God. And who knows, but that by balloons, this may be effected? Who will have the presumption to say that such a consumation will *never* be realized? And if *realized*, will it not present a literal fulfilment of 'Angels flying through the midst of the (aerial) heavens, having the everlasting gospel to preach to them that dwell upon the earth, and to every kindred and nation?'

"To these high and beneficent purposes we may add the gratification of curiosity and pleasure, as a very strong inducement to an encouragement to the practice of the art, in which with any tolerable degree of caution and information, there appears very little of real danger. We have heard from Mr. Wise, and all who have tried the experiment testify to the same, that the beauty and grandeur of the prospect afforded by an aerial excursion cannot be exceeded, much less described. Nor do aeronauts ever experience the least of that giddiness consequent upon looking from great heights connected with the earth; nor have they any of that sickness arising from the motion of a vessel at sea. Many have been carried by balloons at the rate of thirty, forty and fifty miles per hour, without feeling the least inconvenience or even agitation of the wind, for the reason that the machine moves with the wind and its velocity."

The following is an extract of the most important part of the journal kept on the occasion: Left the earth at two o'clock thirty-five minutes; the lower current of wind from southwest moving moderately. At three o'clock, I passed on the south side of Mechanicsburg, at an altitude of about a mile, and still ascending. When at a considerable height above the clouds, another current blowing from northwest was encountered. This gave me an opportunity of making north or south latitude while pursuing my voyage eastward, as the occasion required, by sailing with one or the other of these currents. While nearing the Susquehanna River, a magnificent view was opened; York, Carlisle, Harrisburg, and even Lancaster, were embraced in this grand panoramic view, with all its innumerable villages and variety of splendid scenery. Upon its beauty I will not attempt to descant; it must be witnessed to be appreciated. Although the Creator has allowed me to enjoy this sublime privilege, he has not endowed my humble capacity with language adequate to express its grandeur. In viewing this scene of earthly glory, I was forcibly struck with the idea, that we are not of near so much importance in the eyes of Deity as man presumes himself to be; and not more so to the Creator than the minutest animalcule is to man. And now, in reference to the puerile fanaticism of "Millerism," I would remark that the world, clothed in her verdant summer garb, looked so young and so beautiful, and so far from having the slightest appearance of decay, or an intention of committing suicide by elementary self-destruction, that she reminded me of a gay and blooming maiden just emerging from the days of her innocence into sober womanhood. If any of the deluded followers of Miller doubt this, let them go aloft of a fine summer's day, and view the earth, and if they then don't abandon their nonsensical views, nor feel ashamed of their narrow-minded conceptions of the goodness and greatness of the Creator, they must indeed, be weak in the spirit, as well as in the flesh.

[The Miller fanaticism was raging at that time in that neighborhood.]

At three o'clock twenty minutes, I passed over a vast body of clouds, which reflected a powerful heat against the balloon, causing it to rise to a great height while in the field of reflected rays, and, therefore, obscuring from my view Harrisburg, and to the south, as far as York, the whole of the country. The current below, however, being nearly at right angles in its direction to that above, consequently, soon cleared the space beneath me. My course now lay down the west side of the river. Seeing the necessity of making more south latitude in order to reach my port, until a point was reached nearly over the mouth of Codorus Creek, I soon after descended into the lower current, coming from the southwest, by which I could reach a point near the city of Lancaster, which was now in full view. This took me over the town of Marietta a little after four o'clock, and almost in a direct line for Lancaster. At fifteen minutes before five o'clock I reached a point within a few hundred yards of the city bounds, where I came down. Seeing the people rushing out of the city, a-foot and a-horse, old and young, great and small, rich and poor, intermingled with strains of music and the ringing of bells, I was soon encircled by my fellow citizens of Lancaster, into whose custody I most cheerfully submitted myself, and will now let the balance of this interesting experiment be detailed by my old and esteemed friend, John W. Forney, Esq., of the "Lancaster Intelligencer and Journal," who was an eye witness of the scene.

BEAUTIFUL AND INTERESTING SPECTACLE.

"About a quarter before four o'clock on Saturday last, a black speck, no bigger than a man's hand, was seen a little north-west of this city. Some pronounced it one of Miller's 'signs'—some declared it to be a new and unrecorded phenomenon—and while all were thus arguing as to its character, the speck grew larger and larger, until, at last, the impression began to prevail that it was no less a personage than the great aeronaut, our townsman, *Wise*, who had started that afternoon from Carlisle, a distance of some fifty-four miles by rail-road; and, with a precision equal to that of the recent discoverer of aerial navigation, in England, he had *directed* his chariot with such admirable generalship through the regions of space, as to hang suspended, a little more than two hours after his departure from Carlisle, over his native city! The day was one in which all the clearness and moderation of May were combined, and the whole of the town had an opportunity to enjoy the rare and interesting sight. As the aeronaut gradually approached our ancient city—his balloon slowly increasing its dimensions—every man, woman and child was out to watch its movements. At last, after having hung for nearly an hour in full view, he calmly and gracefully descended in his chariot of the clouds, a short distance south-west of the city, where he was followed by crowds of horse and footmen.

"Supposing all to be over, the curious spectators retired; when, about five o'clock, the whole town was again astir, to witness the aeronaut's triumphal entry into his native city. This was a singularly novel and interesting sight. Standing in the car of his balloon, the huge globe above still distended, almost touching the sides of the houses, and apparently eager for flight, he sailed through the streets at a slight elevation from the ground; his airy chariot drawn, or rather *guided*, by a number of young men and boys who had attached themselves to the rope which led from his car. In this way, with hat in hand, and amid the cheers of his fellow-citizens, Mr. Wise passed through West King Street, and halted in Centre Square, immediately fronting North Queen Street. Here he was again greeted with the cheers of the people; but the sport was not yet over. After a rest of about fifteen minutes, it soon became evident that Mr. Wise was about to attempt an ascension from Centre Square!—a rather contracted area, by-the-way, and too much walled in with houses, we should suppose, to make a balloon ascent either safe or pleasant. But Mr. *Wise* is not one of your holiday soldiers—his whole demeanor on Saturday proved him to be cool, collected and intrepid, even to a fault. Having divested himself of nearly all his clothing but his pantaloons, even to his shoes, and detached the car from the balloon (the gas having been expended so much as to render the balloon incapable of carrying a heavy load), Mr. *Wise* took his seat on a narrow board attached to the cords of the balloon, and giving the signal to 'let go,' away he shot like an arrow from a well strung bow, and nearly in a straight line, leaving behind him hundreds who were amazed at the singular boldness of the daring feat. He ascended, we should suppose, nearly a mile, and was fast fading from sight, when he began to descend, and actually alighted about two squares from the place of starting! This unparalleled performance was accomplished with great ease and rapidity, and proves Mr. Wise to be an able and experienced aeronaut. When he reached terra firma, he was again taken in charge, and escorted or rather sailed to his residence through North Queen and East King Streets, where he was congratulated by the hearty cheers of his fellow-citizens.

"Taken altogether, last Saturday evening will long be remembered with pleasure by our citizens. It was no less gratifying to Mr. Wise to make so grand a triumphal entry into his native city, than it was to his friends and fellow-citizens to see the skill and ability he displayed in managing his steed of the air. We are pleased to learn that a handsome collection was taken on the spot, as an earnest of the public gratification, and paid over to Mr. Wise.

CHAPTER XIX.

Determination to cross the Atlantic by balloon—Intention of proclamation—Publicity of it—Comments on it—"Ballooning extraordinary"—Another extract—Volunteers for the project—Officers of the navy—Their letter.

After my Carlisle ascension, I again appealed to my friends for their assistance to enable me to carry out the transatlantic project, but got no further with them than a promise to promote my petition which I had determined to lay before the next Congress. Believing that something would certainly come out of that, and always looking ahead in matters of this kind, I deemed it advisable to make a sort of a world's proclamation of the contemplated enterprise, which was done for the following reasons. Although I believed, and do still, that the *solar current* which I have invariably found above, blows clear around the earth, still, a voyage across the Atlantic might subject the navigators to local currents and storms, and at best, to all the omissions, imperfections and unforeseen necessities attendant upon all first trials of this nature; consequently, there should be a general knowledge abroad, before the experiment would be made, so that in case of the balloon giving out from any cause, while over the ocean, any ship at sea, being in sight of it, would come to its assistance.

I prepared the proclamation and handed it to Mr. Forney, of the "Lancaster Intelligencer," who prefaced it with his own remarks; and a number of speculative commentaries were written by other persons concerning it, as it passed through the newspapers. Some of these will be related, and it will be observed how difficult it is, in looking at new projects; to separate the *ideal* from the *real* merits of the case. However, the proclamation has gone forth in the world, and the *substance* of it will follow, just as certain as steam followed horse-power.

AERIAL VOYAGE ACROSS THE OCEAN.

"The following announcement of Mr. Wise, the distinguished aeronaut, is one that cannot fail to excite public attention in a very great degree. Though the scheme may look somewhat Quixotic, we have no doubt Mr. Wise possesses the nerve to attempt, and, we believe, has the ability to carry it out! Our New York friends therefore, must not be astonished to see our intelligent and scientific aeronaut arrive in their city, next year, with his 'large balloon,' and take his departure thence for the regions of the Old World.—Would it not create a stir that would far exceed the reception of a hundred Presidents, though every man was a Tyler? And, then, what a sensation he would produce in England, as, coming along the channel, he made preparations to settle down his aerial chariot in the heart of the great London world—or, missing this, suppose him dropping in upon the Frenchmen, at Paris, or Calais, or Bordeaux—or, going further still, suppose him wafted into Constantinople, dashing down unceremoniously, and without notice to the Sublime Porte! Why, our townsman would become more justly renowned than did Captain Ross in his voyage to the North Pole, or Lewis and Clarke in steering up the Mississippi—or the ambitious searcher after the still mysterious source of the Nile! [Not at all, for it is too easy a thing to accomplish.]

"Mr. Wise speaks for himself, however, in a tone of easy confidence that will surprise no one who knows his courage and resolution:—"

"J. W. Forney, Esq.—You will confer a favor to the enterprise in contemplation, by giving the following proclamation publicity, for general notice to the civilized world.

TO ALL PUBLISHERS OF NEWSPAPERS ON THE GLOBE.

"As it is my intention to make a trip across the Atlantic Ocean with a balloon, in the summer of 1844, and as the descent or landing of balloons, in my experience, has almost universally created unnecessary alarm and consternation to the people near by, I therefore give this general notice to the sea-faring community, of all climes, that should they, during any time hence-forth, chance to be in the vicinity of a balloon, either on the ocean or in the atmosphere, they need not be under any fearful apprehensions, but endeavor to give aid to its adventurers.

"It must not be inferred from this, that its success is considered improbable, but merely to be prepared for all emergencies.

"Having, from a long experience in aeronautics, been convinced that a constant and regular current of air is blowing at all times from west to east, with a velocity of from twenty to forty, and even sixty miles per hour, according to its height from the earth; and having discovered a composition which renders silk or muslin impervious to hydrogen gas, so that a balloon may be kept afloat for many weeks, I feel confident, with these advantages, that a trip across the Atlantic will not be attended with as much real danger as by the common mode of transition.

"The balloon is to be one hundred feet in diameter, which will give it a net ascending power of twenty-five thousand pounds—being amply sufficient to make everything safe and comfortable. A sea-worthy boat is to be used for the car, which is to be depended on, in case the balloon should fail to accomplish the voyage. The boat is also calculated on, in case the regular current of wind should be diverted from its course by the influence of the ocean, or through other causes. The crew to consist of three persons, viz.: an aeronaut, a sea navigator, and a scientific landsman.

"Therefore, the people of Europe, Africa, Asia, and all other parts, on the ocean or elsewhere, who have never seen a balloon, will bear in mind, that it is a large globe made of cloth, ensconced in a net-work, with a sloop hanging underneath it, containing the latest news from the United States, and crew of the world's obedient servant."

"*Lancaster*, June, 1843."

This announcement was generally published throughout the Union, and throughout civilized Europe, and although its substance has not yet been accomplished, its postponement is attributable to a single cause—want of pecuniary means to do it *right*. If Congress will *not* give the small appropriation necessary—ten or fifteen thousand dollars—to give it effect (I will not say to make an attempt, because its consummation is as certain as that a sail-ship can do it), our wealthy merchants of Philadelphia and New York cities should take it in hands, since it would enhance their facilities so much.

The following is another among the many commentaries that were elicited by the announcement, and, although it breathes a progressive and well tempered spirit, it is nevertheless strongly tinctured with that inseparable sentiment so common to human nature, which undervalues projects that emanate from persons whom it is intimately acquainted with, and who have never *yet* accomplished great undertakings. However, the article contains so much good sound sense, along with its humor and irony, that I will cheerfully bear the latter, in consideration of the former, and publish it for what it is worth.

BALLOONING EXTRAORDINARY.

"That daring and (as the phrase goes) intrepid aeronaut, Mr. John Wise, of Lancaster, has issued a formal proclamation to the world, announcing that in the summer of 1844 he contemplates making a balloon voyage across the Atlantic, having from long experience in aeronautics become persuaded, that such a mode of transition is not only feasible, but attended with fewer risks than those in ordinary use. He deems this timely notice due the sea-faring community, who, in looking aloft may chance to descry him in the clouds, and who might otherwise be induced to class his 'coming' among the many mysterious 'signs and wonders' of the age.

"But pray, why should not a trip across the Atlantic, in one of these silken cloud-coaches, be entirely practicable? To *us*, it is true, the project may look like the effervescense of a disordered intellect, and we may decry the undertaking as part and parcel of the impossible—but how many years is it, since the man who first threatened to cross the ocean in a simple steam-carriage, with no *sails* but a kettle filled with boiling water, was laughed at as a creature fit only for the friendly ministrations of the keeper of a mad-house? A shaved head and a strait waistcoat were the promised rewards of the original projector of that most noble enterprise. —And yet the foaming billows of the great deep are at this day hourly plied by the rushing steam-ship, bounding and puffing recklessly along, as though it were itself the victim of the madness ascribed to its projector, but landing, nevertheless, its precious freight unharmed upon the distant shores? Now, if such stupendous and astonishing results *have been* realized, what may not man, under the irresistible dominion of the great master-spirit of the age, *Progress*—what may he not accomplish? If the one event has been taken out of the narrow bounds which encircle the diminished catalogue of impossibilities, and has only, like the rising and setting of the sun, ceased to astonish because of its familiarity, why may not the exercise of human effort also consummate the other? And then, after Mr. Wise shall have once successfully pioneered the perilous pathway, and demonstrated that fewer lives are lost by traveling in balloons than by steam and canvass, why should it not ultimately become the universal means of locomotion? Why not, under the guidance of skilful and experienced air-navigators, also adapt balloons to the uses of commerce, as a means of import and export? If men, women, and children, can be suspended for weeks over land and sea, in vessels of silk, upheld by gas, and ultimately reach in safety their places of destination, why not also thus convey the chosen product of every land and clime? Why not *balloon* a load of cotton at Charleston, and in a few days receive the vessel 'bock agen,' freighted with British cloths or a cargo of teas from the 'Celestial Empire.' And then, too, such a 'reform' would spare to our trusty and well-beloved benefactor, Uncle Sam, the necessity of maintaining at such a heavy expense the *Navy*, there being no longer any use for ships and the like, although it might, in turn, subject him to the almost constant tricks of smugglers, owing to the uncertainty of the landing-places. If, therefore, we have not ourselves been all this time engaged in building ' air castles,' Mr. Wise may yet be destined to *soar above* the fame of such common men as Robert Fulton and Oliver Evans."

Another writer says: " We publish below an announcement of the enterprising and intrepid aerial voyager, Mr. Wise, proclaiming his intention of crossing the Atlantic in a balloon! We are not prepared to express an opinion as to the feasibility of this project, but we do not doubt that Mr. W. is ready to attempt it."

Such were some of the numerous commentaries and opinions upon this contemplated expedition, which is *yet* to give the art an impulse that will waken it to its real merits. The following letter, received by due course of mail, post marked New Castle, Delaware, June 28th, shows that there were not wanting proper persons necessary to fit out the expedition under skilful management.

Philadelphia, June 27th, 1843.

Mr. Wise:

Sir.—Perceiving by the newspapers that you meditate an attempt to cross the Altantic Ocean in a balloon next year, and that it is your intention to have with you a scientific person, and a navigator, and as we heartily enter into the spirit of your enterprise, and at the same time place every confidence in your ability to complete the undertaking, we cheerfully offer you our services in the latter capacity (that is as navigators).

If you should conclude on accepting of our company, we are in hopes you will inform us at as early a period as possible, so that we may signify our wishes to, and obtain the necessary permission from the Navy Department.

Very respectfully, your obedient servants,
ARCH. M'RAE,
SILAS BENT,
Passed Midshipmen U. S. Navy.

CHAPTER XX.

Second ascent from Carlisle—Editorial note of it—Narrative—Entering a storm cloud—Hoar-frost in it—Hail and snow forming in it—Could not get out of it—Terrific predicament—Remained in it twenty minutes—An age of time it seemed—Escape from it and descent—Professor Espy's interrogatories concerning it—Petition to Congress for an aerial project.

On my return to Carlisle, it was determined that I should be requested to repeat the experiment, as the first had only enhanced the desire for a second, in those that witnessed it, and many people from the surrounding country who had not seen it, were now very anxious for an opportunity of witnessing such an achievement. Consequently, the 17th of June was appointed for the occasion.

One of the newspapers prefaced the narrative of this voyage in the following terms: "Our own thoughts were a good deal bent toward Bunker Hill on Saturday, but nevertheless, we had on the same day in our own town a spectacle of an *elevated* character and of a thrilling and exciting interest. As upon the former occasion, Mr. Wise's forty-first ascension with his balloon, drew together an immense concourse of the 'beauty and chivalry' of Cumberland and Perry counties. It is not necessary to say more than that it went off with the greatest *eclat* and seemed to have given the highest gratification to all who witnessed it.

"We are indebted to Mr. Wise for the narrative of his aerial voyage, which is subjoined. It will be seen that he encountered insuperable difficulties, and not a little danger, which brought him back to earth again after a trip of a few miles. Mr. Wise is to be congratulated on his safe and fortunate escape from the dangers of that 'long low black' cloud, which from his description one might judge to be the very dominions of the evil 'prince of the powers of the air.' The narrative possesses much interest."

NARRATIVE.

According to announcement, I started on Saturday last on my forty-first aerial excursion, from the Centre Square of Carlisle, at precisely fifteen minutes past two o'clock in the afternoon, it being the 17th of June, 1843. A slight breeze from the west wafted me a short distance in its direction horizontally, after which the ascent became nearly perpendicular until the height attained was about 2500 feet, when the balloon moved off towards the east with a velocity much greater than that of its ascent. The first thing that drew my attention, was the immense ocean of heads that was presented in the square below. There appeared to be infinitely more people on the immediate ground than was usually the case, and the whole scene was rendered highly animated and imposing by the fine appearance of the military, and their repeated salutes of thundering artillery, at the departure of the "Comet." When I had reached a point about two miles east of the town, there appeared, a little distance beyond and above me, a huge black cloud. Seeing that the horizontal velocity of the balloon would carry it underneath and beyond the cloud, rising slowly as it did, and being desirous to gratify the spectators with the novelty of seeing a balloon pass through a cloud, preparations were at once made to effect it by throwing out some ballast as soon as its border should be reached. Harrisburg was now distinctly in view, and the balloon moving directly for it; I was hesitating, with the bag of ballast in my hand, whether I should throw it out for the purpose designed, or continue straight on as I was then going, to the place just mentioned. At this time I had reached a point underneath the cloud, which was expanding, and immediately felt an agitation in the machinery, and presently an upward tendency of the balloon, which also commenced to rotate rapidly on its vertical axis. I might now have discharged gas and probably passed underneath it; but, thinking that it would soon be penetrated, and then might be passed above, as it appeared not to be moving along itself, I made no hesitation in letting the balloon go on its own way. This part of the feat, however, I had reason to regret soon afterwards; although at the present time, it gives more real pleasure in contemplating its terrific grandeur and reality, than anything that has ever transpired in my aerial adventures. The details that shall here be given of this terrible scene may be relied on, as I was sufficiently composed to appreciate its grandeur and observe its physical operations. The cloud, to the best of my judgment, covered an area of from four to six miles in diameter; it appeared of a circular form as I entered it, considerably depressed in its lower surface presenting a great concavity towards the earth, with its lower edges very ragged and falling downwards with an agitated motion; and it was of a dark smoke color. Just before entering this cloud, I noticed, at some distance off, a storm cloud, from which there was apparently a heavy rain descending. The first sensations that I experienced when entering this cloud, were extremely unpleasant. A suffocating sensation immediately ensued its entrance, which was shortly followed by a sickness at the stomach, arising from the gyrating, swinging motion of my car, causing me to vomit several times in quick succession most violently, which, however, soon abated and gave way to sensations that were truly calculated to neutralize more violent symptoms than a momentary squeamishness. The cold had now become intense, and everything around me of a fibrous nature became thickly covered with hoar frost; my whiskers jutting out with it far beyond my face, and the cords running up from my car looking like glass rods, these being glazed with ice and snow, and hail was indiscriminately pelting all around me. The cloud at this point, which I presumed to be about the midst of it, from the terrible ebullition going on, had not that black appearance I observed on entering it, but was of a light milky color, and so dense just at this time, that I could hardly see the balloon which was sixteen feet above the car. From the intensity of the cold in this cloud, I supposed that the gas would rapidly condense, and the balloon consequently descend and take me out of it. In this, however, I was doomed to disappointment, for I soon found myself whirling upward with a fearful rapidity, the balloon gyrating and the car describing a large circle in the cloud. A noise resembling the rushing of a thousand mill-dams, intermingled with a dismal moaning sound of wind, surrounded me in this terrible flight. Whether this noise was occasioned by the hail and snow which were so fearfully pelting the balloon, I am unable to tell, as the moaning sound must evidently have had another source. I was in hopes, when being hurled rapidly upward, that I should escape from the top of the cloud; but, as in the former expectations of an opposite release from this terrible place, disappointment was again my lot, and the congenial sunshine invariably above, which had already been anticipated by its faint glimmer through the top of the clouds, soon vanished with a violent downward surge of the balloon, as it appeared to me, of some hundred feet. This only subsided to be hurled upward again, when, having attained its maximum, it would again sink down with a swinging and fearful velocity, to be carried up again and let fall, which happened eight or ten times; all this time the storm raging with unabated fury, while the discharge of ballast would not let me out at the top of the cloud, nor the discharge of gas out of the bottom of it, though I had expended at least thirty pounds of the former in the first attempt, and not less than a thousand cubic feet of the latter, for the balloon had also become perforated with holes by the isicles that were formed where the melted snow ran on the cords at the point where they diverged from the balloon, and would by the surging and swinging motion pierce it through.

I experienced all this time an almost irresistible inclination to sleep, notwithstanding a nauseating feeling of the stomach, causing me to vomit several times, and the terrible predicament I was placed in, until after eating some snow and hail mixed, of which a considerable quantity had lodged on some canvass and paper lying in the bottom of the car. After this, I felt somewhat easier in mind and in body (for it is no use to say that I cannot be agitated and alarmed), and I grasped a firm hold of the sides of the car, determined to abide the result with as much composure and observation as the nature of the case would admit; for I felt satisfied it could not last much longer, seeing that the balloon had become very much weakened by a great loss of gas. Once I saw the earth through a chasm in the cloud, but was hurled up once more after that, when, to my great joy, I fell clear out of it, after having been belched up and swallowed down repeatedly, by this huge and terrific monster of the air, for a space of twenty minutes, which seemed like an age, for I thought my watch had been stopped while in it, till a comparison of it with another afterward proved the contrary. I landed in the midst of a pouring rain, on the farm of Mr. Goodyear, five miles from Carlisle, in a fallow field, where the dashing rain bespattered me with mud from head to foot, as I stood in my car looking up at the fearful element which had just disgorged me.

The density of this cloud did not appear alike all through it, as I could at times see the balloon very distinctly above me, also, occasionally, pieces of paper, and whole newspapers, of which a considerable quantity were blown out of my car. I also noticed a violent convolutionary motion, or action, of the vapor of the cloud going on, and a promiscuous scattering of the hail and snow, as though it were projected from every point of the compass.

Such is the history of this short but magnificent trip, and I can assure my readers, that when I again meet clouds of this character (which I shall name the cloud of terror), I will endeavor with all my skill, to avoid them.

After this account had been published and found its way in the newspapers, I received the following letter from Professor Espy, at Washington City, which was promptly answered.

Washington City, July 5th, 1843.

Dear Sir: I was much interested with the account you gave in the public papers of your balloon ascension on the 17th of last month from Carlisle.

You will confer a great favor on me if you will answer the following questions: Was there any rain or hail at the surface of the earth under the cloud which you entered? Did you descend through the base or lower part of the cloud, or did you get out of the cloud and descend in the clear air? Was the cloud into which you ascended surrounded by clear sky, or was the whole sky covered with clouds? Have you any reason to think there was an upmoving current of air going up into the base of the cloud and continuing in the cloud itself, or did the velocity of your upward motion merely correspond with the buoyant power of the balloon? What was the cause of your ascending and descending eight or ten times, and how did you judge that this ascending and descending really occurred? Had you a barometer? Do you suppose the cloud was colder than it was on the outside of the cloud at the same height? Or not so cold? Are you sure your balloon was torn by the hail? Or might not you have ascended much higher by a very rapid motion, than you supposed, and your gas have escaped by expansion through the bottom of the balloon?

If there was a strong current of air under the cloud and in the cloud upwards—might you not in the time have gone so high as to diminish the pressure on your body so rapidly that part of the noise which you heard was the ringing of your ears? And might not the sickness have been from the same cause?

If you find time to answer any of these questions, I will be much obliged to you. Yours, very respectfully,

JAMES P. ESPY.

When Congress had assembled at Washington, the following petition was submitted to their consideration, and when we take in view the small amount ($15,000) it would have taken to prepare the experimental outfit, backed as it was by competent authority, it seems little encouragement is to be expected from that quarter, in any new enterprise, no matter how plausible, unless it carries with it some partisan force and object, calculated to promote aspiring and factious individual interests in some political fortune.

TO THE CONGRESS OF THE UNITED STATES.

To the Honorable, the Senate and House of Representatives of the United States of America in Congress assembled:—

The petition of the subscriber, citizen of Lancaster, Pa., most respectfully showeth, that, from an experience of a number of years in the practice of aeronautics by the subscriber, it has been fully demonstrated that there exists in the atmosphere a constant current of wind, moving from west to east, with a velocity of from twenty, forty, and even sixty miles per hour, according to its height from the earth.

This current is moving in that direction, while the local currents may be, and are, moving in various other directions: This *eastward* current is governed by a great general cause, blowing at all times—making it feasible to travel the globe in that direction by aerial machinery, with great facility.

Your petitioner would further state that the art of making aeronautic machines has been so far improved that they may be kept afloat for any reasonable length of time, even for years, and as long as a ship can be made to endure the sea for common purposes.

The main object of your petitioner is, to bring into useful requisition, for the purposes of speedy and safe transition of persons and merchandise, that great natural and unoccupied element, the atmosphere.

Your petitioner does not pretend to have discovered or solved any great new-fangled problem; but would most earnestly press upon your consideration known facts, which must be explored, before any great benefits can be derived therefrom.

From the improved state to which aeronautic machinery can be perfected, and the advantages continually at hand from the local currents of air, it is even now feasible to travel eastward with a velocity that will circumnavigate the globe in from thirty to forty days, with an ability to vary from a straight course thirty or forty degrees from the latitude of departure, which would enable us to leave dispatches in Europe and China, and return by way of Oregon Territory to Washington City.

This has been demonstrated by experiments made by your petitioner, in reaching points sixty and ninety miles distant from the place of departure, with a precision not surpassed by ship sailing, aided by the local currents in varying from the great eastward current.

From these considerations, your petitioner is induced to ask your honorable bodies to make a naval appropriation to carry this project into practical operation. Its practicability having already received the confidence of scientific men, and an earnest and voluntary offer by several officers of our navy, to accompany the first experimental adventure.

Your petitioner, therefore, prays you to make an appropriation for an outfit to this effect, viz.: The construction of an aerostadt of 100 feet in diameter, of substantial domestic cotton drilling; a sea-boat capable of enduring the ocean, for a car, and so constructed that the masts and rigging may be stowed away, ready for erection into sea-service at any time that emergency *might* require. The sea-boat to be of 10 or 12,000 pounds weight; an aerostadt of 100 feet diameter, having an ascending power of over 25,000 pounds, which will be sufficient to carry the outfit and crew.

Should this meet with your congressional approbation, your petitioner will readily submit a plan in detail, and will cheerfully superintend the construction of the machinery at his own expense, asking nothing more than the command or directorship of the first experimental aerial voyage round the globe.

The whole cost of the experiment will not be more than a fraction of that of the late "Exploring Expedition;" and promises, at least, greater results.

For a favorable decision of your honorable bodies, your petitioner feels in duty bound to pray.

JOHN WISE.

Lancaster City, Dec. 20, 1843.

This petition was received, read, and referred to the Committee of Naval Affairs, where it sleeps, soon to be awakened up again by the unconquerable force of human destiny.

CHAPTER XXI.

Ascent from Hollidaysburg, Pa.—Balloon "Vesperus"—Hollidaysburg papers—Narrative—Difficulty of inflation—Net broke—Ascent—Atmosphere squally a mile up—Net giving way—Fearful apprehensions—Expedient—Descent—Went up again, hanging outside of the car—Dashed into a tree—Escape of balloon—Came down in Catskill Mountains, N.Y.—Alarmed the people—Recovery of balloon, &c.

A NUMBER of voyages were made during the summer of 1843, from Lancaster, York, Pa., Winchester, Va., and the next summer from Fredericksburg, Va., none of which elicited anything remarkably new or extraordinary, from what has been already related. But the next one, which was made from Hollidaysburg, Pa., is one full of interest and instruction. This was made with a balloon composed of a new kind of material—Tassore silk, a fabric made by the natives of China from the cocoon of the wild silk-worm which browses upon the wild shrubbery. The Comet was sold to Mr. Crever, a pupil of mine, who made several very splendid ascensions with her. The following extracts are taken from the "Beacon Light" and "Register," of Hollidaysburg, which go to show the nature of the preparatory circumstances, as viewed by disinterested spectators. The "Beacon Light" says:

"The projected ascension of Mr. Wise, on Saturday (May the 4th, 1844), attracted general attention in Hollidaysburg and its vicinity, and public expectation was on tiptoe to behold a spectacle, sublime in itself, and possessing, in addition, to a large majority of our population, all the charm of entire novelty, no other attempt to visit the upper air ever having been made in these parts."

* * * * * "The preparations were made, the basket secured, the intrepid aeronaut took his stand in his frail car of wicker-work, and, having received letters for Harrisburg, Lancaster, and Philadelphia, and risen nearly to the top of the enclosure with a rope attached, 'cut the connection' with mother earth, and moved off to the north-east, immediately over the town. The balloon rose slowly until the disposal of a few bags of ballast relieved her of a portion of her burden, when she arose beautifully to a great height, her daring tenant waving his hat to the crowd below, who, with upturned faces, and hats waving, cheered him on his venturous way. After attaining this elevation, the balloon encountered a current of air *flowing to the east*, in which direction it moved off like a thing of life, and in a few minutes was entirely lost to view." * * * * * *

The "Register" has the following: "The ascension of Mr. Wise, in his new and beautiful balloon 'Vesperus,' took place on Saturday last, according to notice given. The day was entirely too stormy for an undertaking of the kind, and, in the opinion of every reasonable man, would have justified Mr. Wise in postponing the adventure; but, trusting in the excellence of his vessel and his skill as an aeronaut, he determined to make good his appointment and to satisfy every individual of his numerous audience. He accordingly, after a most laborious and oftentimes discouraging effort, succeeded in sufficiently inflating his balloon, and getting ready for the voyage, and at the hour appointed cut loose.

"The ascent, although evidently hazardous, from the rupture in the network by which he was attached to the balloon, and from the unsteady and squally state of the atmosphere, was sublime beyond description. When the cord was cut, he rose slowly from the arena, barely clearing the top of the enclosure, and taking a northern direction he swept across the town, just escaping the house tops; but, discharging a couple of sacks of ballast, he soon mounted high into the aerial regions to mingle with, as we supposed, the less angry elements above. But in this we were mistaken, for, long before the 'Vesperus' was out of sight, she was observed to be rocking strangely, as if the elements were no more friendly with her in her elevated position than when bound to earth. The account subjoined, by Mr. Wise, gives a full history of this part of the adventure.

"The ascent of a balloon is a spectacle that to be realized must be witnessed. No description can convey a just idea of its sublimity and beauty, as, like some creature of life, it smoothly and silently, and steadily mounts upwards, with its golden sides glittering in the rays of the sun, and its tiny basket and well-arranged cordage swinging gracefully beneath. And then as the intrepid aeronaut waves his hat at a fearful altitude and sends down a faint response to the loud huzzas below, and every breast heaves deeply with the conflicting emotions of admiration, fear, sympathy, and desire for like adventure, a thrill runs through the soul that no description can produce, however true and vivid.

"We need only add here, as the evidence will be given again, that Mr. Wise's conduct on the occasion was highly satisfactory to all concerned, and must greatly increase his reputation as an aeronaut; for we venture to say no other individual ever attempted an ascension under like unfavorable circumstances.

"At about eight o'clock in the evening we heard of his return, and, repairing to the U. S. Hotel, we found Mr. Wise, somewhat disheartened about the loss of his balloon, and looking rather worse for the trip—his outer man having suffered considerably from his adventure among the branches of the tree on which he lodged."

NARRATIVE.

The process of inflation was commenced at eleven o'clock A.M., under very disparaging circumstances, as the elements had combined from all points of the compass to a general and boisterous storm. Nothing, in short, but the most indefatigable energy and perseverance on the part of Mr. Downy and Mr. Woods, who had taken a most important charge under their hands, that of keeping the "Vesperus" to her place, could have enabled me to have made an ascension under such a war of the elements. During the process of inflation in the beginning, the reaction of the gas from the balloon, caused by a sudden flaw of wind, blew off the gasometer, which was soon replaced by my energetic friend Mr. Hinkle, and the inflation resumed, but under so much violence of the apparently frantic gamboling of the "Vesperus," surging to and fro the persons who were holding on to it, that I began to fear of their ability to endure the rough usage they were laboring under all the time, sometimes being partly raised up and then dashed to the ground, as by a maddened steed. However, after getting the assurance of those gentlemen that they would hold on, to use their own words, "to the last ribbon," I retained my confidence in accomplishing the ascension, until I received the heart-sickening information from my friends that the network was fast giving way about the top of the balloon. I now began to give up hopes of getting up, and even feared that the balloon would break through her trammels and escape; but Providence sent a gleam of sunshine, with a short abatement of the storm, during which time a good supply of gas was worked into the "Vesperus," sufficient for a long voyage.

At precisely three minutes past two o'clock, I mounted the car, and having ballasted the vessel while it was restrained by a cord, feeling, as I supposed, the rupture in the network increasing at every surge, which by this time had got so large, that a bulb as big as a hogshead was protruding through it, my preparations were speedily completed. Knowing now that time was precious, I cut the rope and gave my friends below a parting salute, which was heartily responded to by a thousand voices.

When afloat, I began to congratulate myself upon the victory that was gained over such formidable obstacles below, and felt a composure that the network would stand it safely now, as the balloon was free in the air. She took a northerly direction, ascending rapidly all the while, until an altitude of about a mile was attained, where a violent gale was encountered which made the balloon surge off in an easterly direction, swinging the car to and fro, and making the network crack at every surge, which alarmed me about my personal safety. Looking over the edge of my car at the immense depth to the surface of the earth, my heart began to sicken at the idea of falling that immense distance with nothing but the network and car to rely on; and my sensations were rendered still more gloomy by the lowering appearance of the heavens in every direction, as around and beneath the clouds could be seen discharging torrents of rain and wind, with, as I supposed, the moral certainty of the balloon's escaping from the network in a very few more surges. I could see the valleys west of the Alleghany Mountain, on which the sun was shedding its beams of light and life.

I looked up at the balloon, and it appeared to me that the car was receding from it gradually, by the giving way of the network, and at this crisis an expedient flashed across my mind—the valve rope would bear the weight of a hundred pounds, and the top of the balloon was equally strong—my weight was thrown upon it at once. This necessarily opened the valve to its full extent, and must soon bring the machine down to the ground. The velocity of the wind was about fifty or sixty miles per hour, and, between this and a rapid descent, terra firma was reached about sixteen miles east of Hollidaysburg. As soon as practicable, an anchor was thrown out, which grappled in a fence and capsized it, when the machine bounded across the field, where it caught in the next fence but broke it, carrying with it a fence rail, causing the car to bound and rebound from the earth and dashing headlong into a very rugged piece of mountain woodland. At this juncture, I clasped several of the net cords in my one arm and made a spring overboard for a fence that was intercepting my path, and unfortunately for me, at the same time the rail was loosened from the anchor, when the balloon rose with a sudden bound—my body outside of the car—one foot fast in the rigging, and my arm clasping several of the net cords. My right hand was still free, with which I quickly grasped the valve rope which had been tied to the rim of the car, and secured it in my teeth, holding the valve open, when in another moment I found myself dashed into the top of a high tree, where I quickly grasped the limbs, still clasping the cords in my left arm. This brought the balloon to for a moment, when with my right hand a hitch round one of the limbs was taken with the anchor rope. This was followed by a squall of wind which warned me to release my arm hold of the cords, one foot still in the car, when, to my utmost dismay, I found my foot tangled in the rigging. There I was, holding on to the top of the tree with a death grip—head down and feet up, the balloon surging and drawing the top of the tree which I was holding to in the direction of the squall, only abating momentarily for a more violent surge, and I could no longer keep the valve open with my teeth, the rope had become too long, and I could not take a shorter hold, in the dilemma, without incurring another risk—that of letting one hand loose from the tree top ; but things were growing desperate, and I made a violent but successful effort to loose my foot, at the same time grasped the valve rope in my hand, and in another moment a terrible crash indicated the balloon was off—having broken the anchor rope, and jerked through my hand the valve cord, burning it as though a hot wire had passed through it, and I left hanging in the top forks of the tree where I had fallen.

As soon as I had recovered a reasoning position, I looked upward and just saw the balloon dashing furiously off and upward into a dense black cloud, some distance to the northeast. In referring to my machinery, I found that I had taken unnecessary alarm ; the cracking noise of the network must have arisen from the surging motion of the balloon, for the network had gone through double the force since landing, and not torn off yet, proving that it was all-sufficient to have borne its load to its destination, which greatly enhanced my chagrin, since the wind and weather were so favorable to have reached Philadelphia before dark. I began to reproach myself with unnecessary fear, until I saw my hat, map, newspapers, canvass, handkerchief, &c., scattered about below, when I began to think it might have been worse, though I should never see the "Vesperus" again.

After soliloquizing in the tree top awhile upon the day's adventure, I thought it time to come down, for I was near a hundred feet from the ground, leaving part of the anchor rope dangling in its top, as a port of entry for the next aerial traveler who may chance to land there.

Within a few weeks afterwards, I learned that the "Vesperus" had landed, the same day of her departure from Hollidaysburg, at half past six o'clock, on Mr. Van Valkenburg's field in the Catskill Mountains in the State of New York. I repaired thither and recovered the balloon. The persons in the neighborhood were much astonished at its arrival, and it was under considerable apprehension they were induced to examine it. Mr. Van Valkenburg's son was out in the field ploughing round the hemlock stumps when the balloon was coming down, and upon seeing it in the air thought it was an immense bird of prey pouncing down upon him, which alarmed him to a degree that after he had fled to the house he was affected with violent spasms. —The balloon was suffered to roll and toss about the hemlock stumps for some time before it was secured. The next wonder to the persons that secured it was, the newspapers that had remained in the car, they bearing the date of the day on which they found it, and Hollidaysburg was a place they knew nothing of, until they looked over their geographies; and then its being several hundred miles off over the mountains and rivers, puzzled them still more. The balloon was cut in six sections when I got it, Mr. Van Valkenburg informing me that an individual who had come along that way, and who professed to be well informed in such matters, cut it up in that manner for them. The shrubbery which had been twined around the car before it started, had turned entirely black, showing that it had been in a high frosty atmosphere. The balloon had no doubt bursted from the expansion of the gas, which caused it to come down so soon.

Before I took it away all these wonderments of the people were explained to them, and they expressed a great desire to have an exhibition of such a novel kind in their neighborhood. This machine was fixed up again, and after making a number of trips with it, two from the city of Columbia in South Carolina, I sold it to a gentleman of that State.

CHAPTER XXII.

Ascent from West Chester, Pa.—Extracts from aerial log-book—Descent in a thunder storm—Car struck with lightning—Alarm of it—No serious consequences—Another ascent from West Chester—Next ascent was made from Utica, N. Y.—First ever made from that city—"Daily Gazette's" account of it—Another from Utica—Project of war balloon to reduce the castle of San Juan de Ulloa at Vera Cruz—Offer to government—Comments on it—Letter to the war department concerning it.

A NUMBER of ascensions were made which will be passed over silently on account of them not comprising anything that would sufficiently vary from those already recounted. The next one worthy of note was made from West Chester, Pa. On this occasion, it was my intention to sail as near the surface of the earth as practicable, with a balloon of limited size, and the log-book of the voyage will show how far I succeeded in that respect. A balloon of twenty-one feet diameter is very liable to fluctuate in height, compared to that which a fifty or hundred feet diameter one would be. There also occurred an electrical discharge in the ending of this voyage that is worthy of note.

A West Chester newspaper notices it in the following language: "Mr. Wise, the aeronaut, made a voyage to the clouds from this borough, on Saturday last. A dense concourse of witnesses were present, assembled from hill and valley, and town and country—of the young, the old, the gay, the beautiful—sturdy manhood and sweet and blooming maidenhood—it was a great day. Hundreds were there, all agog, with eager curiosity, to see the last wonder of the world—the navigation of the air! The day was damp, which detained the ascension for an hour or so; but it did not stop it—for a little after four o'clock, the balloon was filled—the car attached, and the daring adventurer mounted his impatient courser—the cords were cut; and now he rose from the earth, gradually, easily at first, but majestically, amid a thousand cheers which welcomed him to the skies; upwards he went—and onward—onward, with the winds, until he dwindled to a speck and was lost in the clouds. So ended the grand sight. All was joy and exhilaration, and many a youth will, fifty years hence, relate the vision of that day.

Nothing occurred to mar the harmony of the day except the *accidental* bursting of one of the sand bags as the aeronaut ascended from the enclosure, on the *outside.* The following is from his log-book."

AERIAL LOG-BOOK OF FIFTY-FOURTH ATMOSPHERIC VOYAGE.

BALLOON ROUGH AND READY.

West Chester, Pa., August 8th, 1846.

Four o'clock fifteen minutes, started with a southerly breeze, at the rate of twenty-five miles per hour.

Four o'clock twenty minutes, atmosphere to the south and east perfectly clear. Can see Philadelphia as distinctly now as it has been seen at other times when not more than three miles off. The rain in that direction has cleared the atmosphere. See some sails on the Delaware—sun shining against them gives them a golden hue—vessels as distinct to my view as though I were on the river bank. Four o'clock thirty-five minutes, rumbling thunder to the far north. Four o'clock forty-five minutes, crossed Pennsylvania railroad.

[It may be here observed that the balloon was sailing towards the north-east, and a thundergust was moving from the north-west, about fifty or sixty miles to the north-west of me—thus moving at right angles with each other, and the remarkable result of the balloon meeting the storm at the point of intersection.]

Five o'clock, lost sight of West Chester. Came down now within good speaking distance of the earth, and so low that the Delaware vanished from view. Thunder pealing louder now, but no lightning perceptible. Talking to the people below as I passed along. Dogs barking at the balloon, and poultry dismayed in the barn-yards, keeping an alarming clatter. Distributing newspapers to persons below who run and pick them up. Balloon moving rapidly. A man on horseback in hot pursuit. "Come on, come on, I'll give you the latest news from West Chester." Several papers were dropped now. There, he grasps at one from his horse. "Have you got it?" "*Yes, sir.*" "Good-by, sir," said I. "*Come down,*" says he.

Five o'clock ten minutes, crossed Schuylkill above Norristown—threw out ballast and ascended very high. Can see all around to a great distance. Phœnixville, a little up the river. Going too much east to reach Reading. Come down again to within good speaking distance of the earth.

Five o'clock twenty minutes, near the Trappe, and over the Reading and Philadelphia pike. Invitations from all around me to "come down;" threw over some newspapers to the people—

inquired if I could get supper there. "Yes, anything you want." To cap the climax, one of them sang out—"*Come down, and I will give you a bottle of brandy.*" "Thank you, sir; *spirited* enough; I believe I'll go a little further."

Five o'clock thirty-five minutes, thundergust approaching the track of the balloon. Low enough to hear the wind rustling in the trees. A great many persons following the balloon. Some give up the chase; others strike in with fresh vigor.

Five o'clock forty-five minutes, moving parallel with the Norristown and Sumanytown road. Storm and balloon converging to the same point—vivid flashes of lightning were now occasionally to be seen in the north.

Five o'clock fifty-five minutes, a man on a black horse in hot pursuit up the road—horse's head and tail in a straight line. The race is beautiful and exciting. He is losing ground every jump. Now he holds up a mile behind.

Six o'clock, and moving over a thick wood. Here I ceased taking notes—the car was near the tree tops—thick woods underneath, and a roaring thunder storm just ahead. Already its commotion was acting on the balloon, and it would not do to seek shelter among the trees below, and yet the alternative was to do that or sail right into the teeth of the storm, for there was not ballast enough left to *ensure* an ascent above it before getting into its midst. Indeed, it required all my ballast to keep above the tree tops until the woods were passed, and this brought me right into the thundergust. A number of persons were following me from the woods afoot, but they could not keep pace with the balloon, falling back three quarters in the mile. As soon as a clear spot was attained, the anchor was thrown out, and the moment it struck the ground a vivid flash of lightning hurled the balloon against a tall oak tree. What appeared to me remarkable in this, was the absence of a report, but the fire flashed from my car and flag, the latter hurled out of the basket where it had been stuck in the wicker-work. This flash reminded me of the sparks that fly off from a piece of white-hot iron just taken from the forge on the anvil, and struck with the blacksmith's hammer; and the noise was very similar to that also. Just at this moment, a young man was running to my assistance, intending to catch hold of a drag rope which I had thrown out and requested him to take and make a hitch to a tree with, of which there were plenty around. But the flash brought him up suddenly, and made him stand aghast, and immediately retire. The balloon was now tangled in the oak tree, and the smoke I had observed at the time of the flash, which, with the sulphurous smell, had alarmed me, was the gas issuing from the breaks it received against the scraggy branches of the tree. Fortunate it was, that there was no escape of gas at the time of the electrical flash, or an explosion might, and would, in all probability, have been the result.

The persons who had followed me from the woods, now came up, and before we could roll up the balloon, the gas having escaped readily from the breaches in it, we were enveloped in a terrible storm of thunder, lightning, and pouring rain.

When I returned to West Chester, arrangements were made for another ascension from that place, on the 24th of the same month, but nothing of importance was elicited in its adventure.

In the beginning of the following September, I made an ascension from the city of Utica, in the State of New York, having received an invitation from there. It was the first ascension ever made from Utica. The "Daily Gazette" of that place spoke of it in the following tone: "All who witnessed this ascension, agree to its being one of the most beautiful, interesting, and sublime sights that can be seen. Its peculiar attractiveness, however, cannot be described. There is something in the rise of any inanimate body in the air, that always singularly interests us; witness the kite and ordinary paper balloon. The philosophy of this feeling we do not profess to understand; perhaps it is the satisfaction of overcoming the usual course of nature. Be that as it may, this feeling is immeasurably heightened on beholding a body of the size of Mr. Wise's balloon, some twenty feet in diameter, cleaving its way through the air to the skies. Even without the additional interest of a person ascending with it, the ascension of so large a body would at any time fix the attention of a whole population for hours. But when there is connected with it the idea of a human being carried by its resistless power thousands of feet into mid air, and suspended over the earth at this dizzy height, with nothing but a slender willow basket between him and inevitable destruction, the excitement and interest become almost painful by their intensity. No one will forget the sight till his dying day.

"The ascension of Mr. Wise was an unusually beautiful one. He rose from the garden at an angle, moving off north-westwardly, and at the same time rapidly ascending, so that before he had passed the city limits he was greatly above our highest steeples. Having gone perhaps a couple of miles in that direction, continually increasing his distance from the earth, the balloon, taken by another current of air, was borne more northwardly, and for a short time seemed bound for Trenton Falls, till an *eastwardly* current took it and passed it, hovering over the Deerfield hills, in review of the city. In less than thirty minutes, this great fabric, which had gone out of the garden with such a rush, having gradually diminished to a mere speck against the clouds, went down out of sight beyond the hills.

"Mr. Wise says that, immediately on rising, the whole country around was visible to him; the villages, the streams of water, the fields and forests; the whole appearing as if scattered upon a vast plain, and like an immense garden of indescribable beauty. He was so much elated by the richness and beauty of the prospect, that he could not forbear crying out with enthusiasm, 'Hurrah for old Oneida.' His field of vision extended about thirty miles each way. The south was everywhere full of the evidences of a fertile and thickly settled country, the distant villages appearing like dots on the surrounding verdure, the roads traceable for miles like yellow threads, the water in a thousand places flashing in the sunlight. To use his own expression, 'if the felicity of heaven is comparable to the pleasurable enjoyment experienced when thus viewing the earth beneath one, it is worth a lifetime's devotion for its attainment.' He says he was surprised at the appearance of Utica, which from his ground view he had taken to be a very regular place, but from his elevation, it was the most singular place he had ever seen. The streets were a perfect snarl, the plan of the city exhibiting entire irregularity and its boundaries presenting several sharp points. To the west he could see part of a lake (Oneida), and along the north-east, for an immense extent, lay an unbroken wilderness ('John Brown's tract'). The fear of getting into this region, and being thus unable to fulfil his engagement at the garden, at eight o'clock the same evening, kept him from going above the clouds, which he reached at one portion of his voyage.

"The course of his voyage he describes as being something like the letter S. When he appeared to us, sailing along this side of the summit of the Deerfield hills, he was, in fact, three or four miles the other side, and the descent we witnessed was made at about that distance beyond the top of the hill where he appeared to land. His highest point was made as he was coming from the north, eastward towards the railroad. He then attained a height of about five thousand feet, or nearly a mile. As he passed along he could hear the shouts from the farm houses below, but could not distinguish persons. At the easternmost point of his trip, seeing a village (Russia), with a convenient steeple for him to descend upon, he discharged some of the gas and commenced descending, but as he thought probable, he came again into the westerly current of air which he took on first ascending, and by which he was carried three or four miles, at the height of a few hundred feet only from the earth. In this way he passed over a large forest, and coming to a suitable field, he threw out his line and drew his balloon towards the ground, and finally catching hold of a stake in the fence, made fast, forty-five minutes from the time he left the garden, ten miles from the city. He employed a couple of men to tow him back to Utica, intending to make his first landing in the City Garden, but a storm coming on when he had got within sight of the town, he discharged the gas and packed up his balloon."

In two weeks, another ascension was made from Utica with about the same success and details.

Our government being now at war with the Mexican nation, and hostility between the two countries growing stronger every day, it was determined by our war department that the formidable Castle of San Juan de Ulloa should be reduced. Various projects were under consultation at Washington designed to such an end, upon which I thought it proper to submit the following to our government:—

EASY METHOD OF CAPTURING THE CASTLE OF VERA CRUZ.

The present condition of the war with Mexico will require our forces to reduce Vera Cruz. And it is acknowledged on all sides to be an extraordinarily well fortified point of defence, almost impregnable to the common mode of warfare, and at best cannot be taken in that way without a great sacrifice of life and ammunition. I will, therefore, suggest a plan to our war department, which will render the capture of the Castle of San Juan de Ulloa as feasible and easy as the launching of a frigate.

Although the plan I shall propose may seem novel to many, still a brief detail of it, I think, will satisfy the most incredulous of its efficiency. In the first place, it will require a balloon of common twilled muslin, of about a hundred feet in diameter. This machine, properly coated with varnish, will retain its buoyancy for many days or weeks. It will be capable, when inflated, to raise over 30,000 pounds. Say 20,000 independent of its own weight, network, car and cable. It can be inflated in a day, or less time if necessary. The process of inflation may be accomplished on land, or on board a man-of-war at sea, as circumstances may require. The car to be ladened with percussioned bomb shells and torpedoes to the amount of 18,000 pounds, which will leave two thousand pounds for ballast and men. Thus it will be ready to be placed in a position for deadly action, in a very short time. The cable by which it is to be manœuvred may be at least five miles long, so that the balloon at a mile of elevation would leave the vessel, or land position, which act as the retaining point, out of the reach of the castle guns, and under the cover of our own batteries. The man-of-war balloon hovering a mile above the castle like a cloud of destruction, would be entirely out of danger of the enemy's guns, since they could not be made to bear on an object immediately above them. The position of the balloon as to height, and distance from the retaining point, could be maintained by keeping a proper eye to its ballasting. As it would become lightened by the discharging of shells and torpedoes, an adequate quantity of gas can also be discharged.

If a gun from the castle could be ever made to bear upon the war balloon, it would soon be silenced by the rapidity, precision and certainty with which the deadly missiles could be showered down upon them.

With this aerial war ship hanging a mile above the fort, supplied with a thousand percussioned bomb shells, the Castle of Vera Cruz could be taken without the loss of a single life to our army, and at an expense that would be comparatively nothing to what it will be to take it by the common mode of attack.

Through the medium of your journal I would most respectfully suggest this plan to our government, and will tender my services for its construction, and when constructed, will, if necessary, most cheerfully undertake its directorship into actual service, at a moment's warning.

Yours, respectfully,
JOHN WISE.

Lancaster, Oct. 22d, 1846.

The proposition drew out a great many opinions and commentaries upon the plan, one of which we will state, taken from the "Philadelphia Public Ledger." "The public have been amused by the many comments upon Mr. Wise's plan of taking San Juan de Ulloa by balloons, lading them with men and explosive bombs, raise them over the devoted castle, and let the bombs fall upon it and blow up by concussion. This new method of besieging a fortress has been discussed in every vein of seriousness, wit or contumely, as the idea seemed feasible, funny or absurd to various minds. At a recent party in Frankfort, Ky., the subject became a topic of conversation. After a number of persons had said their say, pro and con, a distinguished wit—an ex-governor of the State—was called upon for his views touching the same. With great dignity he pronounced the plan an admirable one, and the inventor a man of military genius; but, he added, 'I think it will be a very troublesome matter to enlist volunteers for that service.'"

Soon after this, the following note was addressed to the War Department:—

Lancaster, Dec. 10th, 1846.

Ex-Governor Marcy, Secretary of War of the United States.

SIR:—You have no doubt seen, and perhaps somewhat considered over the plan and proposition I suggested through the public prints, for the reduction of the Castle of San Juan de Ulloa by balloon. Were it not for the incredulity and prejudice that invariably meet new ideas and projects, I should from the commencement have submitted it to the War Department, for scrutiny. But believing that it would best be tested by "public opinion" in bringing out serious objections to its feasibility, I chose the course of having it first analyzed in the popular crucible. By this course I would be enabled to discover, what in my first conceptions of the plan might have been overlooked, and thereby save myself the trouble of further urging its merits towards action, as also any formal application for its consideration by the War Department.

So far from any well-founded objections having as yet been urged against its practicableness, I have some of the best minds in the country to sustain the project. And upon a mature and deliberate review of the whole subject, in its minutest details, I write to you with a most unwavering conviction, of not only its practicability, but my ability to give it the desired effect. It will be unnecessary for me at present to enter into any detailed account of the necessary requisites to its consummation, but I will state, that the cost of outfit, independent of the war projectiles, would be but a trifling matter, compared with the magnitude of the work it would be capable of accomplishing. As to the objections that may, or can be urged against its feasibility, I am ready to rebut them with mathematical and philosophical demonstrations. Should the war department desire to have further explanations of its character, or to have any objections to its practicability refuted, they will be explained and met by me upon the first intimation of such a request. The novelty, or chimericalness of its character, will, I trust, have but little weight upon the minds of the intellect composing our government in deterring them from a fair and impartial scrutiny of a subject so pregnant with national welfare.

It has been hinted that it would be difficult to get men that would act in such an enterprise.—This belief is as unfounded as any other I have yet urged against it. It would require but nine assistants in the bomb-car, and that number I will guarantee to secure from our own city.

With an earnest solicitude for its early consideration, I remain your fellow citizen,

JOHN WISE.

CHAPTER XXIII.

Career of 1847—Philosophers should go up with balloons—Earth's attraction—Ballooning only ahead of the age—Letter from Professor Henry, Secretary of "Smithsonian Institution"—Hollowness of the globe demonstrable by the laws of atmospheric pressure—Matter and its laws—Another ascent from Utica—Next from Syracuse, N. Y.—Narrative of it.

In the summer of 1847 I commenced the season's ballooning campaign in the city of Lancaster. Having sold the old Rough and Ready to Mr. Smith, of Utica, a gentleman of high scientific attainments, a new one was made during the winter, which also was named "Rough and Ready." The following extracts are from the journal of this first ascension with the new balloon, which was made on the 7th of June: to wit—I will not on this occasion rehearse the beauties of the Conestogo Valley; but, that the magnificence of the scenery, and natural inspiration of the observer arising from a combination of causes while sailing through the ethereal heaven over such a specially blessed land, must approximate the state of heaven's bliss, I am justified to assume.

It seems to me remarkable that a subject which is theoretically so well understood and so practically safe, as is ballooning, and which holds out such extraordinary inducements to the scientific world, and such grand mental exaltations and developments of nature's poetry, should be so sparingly enjoyed by the philosopher and poet. The United States has never yet been honored with an ascent of one of its notable men with a balloon, while France and Italy each have the credit of one of these rare instances.

Now whatever may be the force and condition of the earth's attraction near any part of its surface, I find that at the height of a mile or two from it, light bodies show a remarkably diminished degree of attraction of gravitation. From a series of experiments made with sand, pith balls, slips of paper, and ribbons, it seems that the balloon and its appendages, attracted them more than the earth did, when they came in close proximity to any part of the machine, or, I might say, when within its individual atmosphere. Frequently, the ribbon, or slip of paper, as the case happened to be, would vibrate between the car and the body of the balloon, *falling up* and down agreeably to the jarrings and motions incident to it. Whether this is attributable to the power of the balloon's attraction, from its being at the time a perfectly isolated body, or from a diminution of gravitation agreeably to the distance from the earth, I had not at the time the means of testing. On a future occasion I will test it with a delicate spring balance, in weighing a body at the earth's surface, and weighing it again at a great height. If the earth is hollow, as the economy of nature indicates it to be, and the law of gravitation arises from the *actual weight or quantity of matter*, a height of three miles from the earth would, no doubt, show an appreciable difference in the weight of bodies. There is a connection between an inflated and duly ballasted balloon and the earth, so extraordinary, which I have for a long time observed, which makes me think that the law of attraction of gravitation is governed by the *actual weight* of bodies, and not by their surfaces. This has been indicated to me in the practice of ballooning, too strongly, to go unobserved, and yet there are so many causes affecting the position of a balloon when near the earth, that I would rather seek its solution by the actual trial of weighing a given body at the two remotest attainable points, than to depend on hypothetical statics alone, which do not sufficiently explain this phenomenon of a balloon's *labor* when near the surface of the earth.

There are so many influencing causes to be taken into consideration in connection with the effects here mentioned, that nothing short of repeatedly varied experiments will be sufficient to determine definite conclusions. We have now systems and sciences, connected with this subject, which are based so much on hypothesis alone, that we should be very cautious in conclusions upon experiments, whether they may, or may not, be fully corroborative of received theories.

In concluding this account I would remark, that ballooning is about half a century ahead of the age, but if the spirit of mechanical progress, necessarily requisite to a high attainment of scientific principles, keeps pace with the onward march of intellect, *our children will travel to any part of the globe without the inconvenience of smoke, sparks, and sea-sickness; and at the rate of one hundred miles per hour.*

While on the subject of attraction of gravitation, it will not be out of place here to state that I addressed a letter to Professor Joseph Henry, on that question, and also regarding the atmospherical currents, and here is his reply:

Smithsonian Institution, May 8th, 1849.

MY DEAR SIR:

The inquiry with regard to the hollowness of the interior of the earth could not be solved by any variation of gravity above the exterior surface, for it can be mathematically demonstrated, that the attraction of a solid globe, and also of a hollow sphere, are the same, as if all the matter of each were concentrated in its centre. The law of diminution of gravitation, as measured above the earth, would be the same in both cases. A spring balance, if sufficiently delicate, would indicate a difference in the weight of a body suspended from it at different elevations. But this, as I have said before, would give no information as to the hollowness of the earth.

I have no doubt that there are great currents in the upper regions of the atmosphere, and particularly the return currents of the trade winds, which should blow continually from south-west to north-east. Should you conclude to make another aerial voyage, I should be pleased to suggest some observations.

Very respectfully, your obedient servant,

JOSEPH HENRY,

Secretary to Smithsonian Institution.

JOHN WISE, ESQ.

It is proper to state that I made the particular inquiry of Professor Henry, whether there was a difference between the laws of electrical attraction and attraction of gravitation, as laid down in received hypothetical science. My own hypothesis is, that as the atmosphere finds its minimum density at about forty-five miles above the surface of the earth, it must necessarily find its maximum density forty-five miles under the surface of the earth, which, according to the law of atmospheric pressure, would bring the air to about the density of water, at that depth below the earth's outer surface, which I presumed to be the thickness of its crust, or shell. According to this law of atmospheric density, and the equally well known law of water's slowly increasing density at great depths—that is, its incompressibility, these two elements could not exist as different or distinct bodies forty-five miles below the earth's surface, but must mingle into one body or one mass from their equal densities or specific gravities, and their equally well established fluidities, and therefore, the relation of distinction in these substances, so important on the earth's surface, must there cease, and the reasonable presumption follow, that a new order of things exists from this point inward. From these established laws of pressure and density, and the fact that water and air are found in the depths of the earth, and the reasonable hypothesis of the earth's hollowness, and its inner cavity being necessarily filled with an atmosphere or fluid of some kind as dense as water, many of the phenomena which we now only know by their actual existence, may be solved by these laws and principles: particularly those of tides, spouting springs, aurora-borealis and volcanic eruptions.

In thus following out these inductive reasonings, I perceived that the weight of the earth would not be much, if any, less, by being hollow, than if it were composed of clay, rock and water all through, which, however, cannot be the case under the known law of atmospheric pressure and density, as, at the very moderate depth of fifty or sixty miles under the earth's surface, air would be vastly denser and heavier than water, clay or rock. Therefore, whether we assume the earth to be hollow, or solid all through, judging from matter and its laws as existing, there could be no solution as to the certainty of the one or the other by the test of weighing a body at the points mentioned with a delicate spring balance.

Pursuing the investigation of matter, and its conditions, under the well-known laws which govern it, we cannot conclude, that at the outer borders of our atmosphere a vacuum commences; but we must rationally conclude, that a new order of matter commences, different from a merely highly rarefied condition of air. Caloric, or what we know by imponderable matter, may at that point assume a character of substantiality sufficiently dense to keep the earth afloat in it. An atmosphere of high pressure steam, seems to be nothing more than water minutely divided and highly charged with calorific atoms, a condition which may be inductively attributed to the medium existing between the planets, and which commences where our atmosphere ceases to exist.

Having in the beginning of this work stated that meteorology should not pass unnoticed, the remarks just made concerning the internal condition of the earth having naturally grown out of it, will not be considered impertinent to the subject.

During the summer of '47, a third ascension was made from Utica on the 5th of July, in which a distance of five miles was made before the descent. No particular journal being kept of the trip, the following notice from the Daily Gazette, of that place, will suffice:—"In about an hour, or an hour and a half, the aeronaut returned with his balloon still inflated, himself in the car, which hung a few feet above the ground, the whole drawn forward by a barouche and accompanied by a crowd of the curious, by whom it was escorted in triumph through the streets to the place from which it ascended. Here a cord was attached to the balloon, and a number of ladies tried a short aerial voyage. None of them have, as yet, however, sent us any account of their discoveries."

The next trip was made from Syracuse, N.Y., July 17th. Part of the journal will be quoted:—Onondaga Lake looked like a tiny fish pond, and the salt sheds around the northwestern part of the town had the appearance of so many market houses strung in parallel rows at different places. Salina, Geddes and Liverpool looked like elongations of the Vena Porta of Syracuse. To the east of me, and apparently not far off, lay two considerable villages, which I cannot name. The great Erie canal also seemed awakened to the scene of the day—the numberless craft on its water held up to see the balloon, the crews of which sent loud and repeated cheers for miles each way. The town appeared like a perfect beehive, and the arena, graced with a tremendous throng—yes, a tremendous throng of Onondaga's *fair* daughters, had all the appearance, when looked upon from so great a height, of one of Aladdin's enchanted scenes. All nature sang in one harmonious strain of music—softly and sweetly faded the shouts, the murmurs, the æolian-like concert of nature's revelry upon my ears, as the last boundary of hearing was passing by.

And now I was far, far above the sphere of human recreation—no sounds, no cheering longer greeted my ears—the fair town of Syracuse, like her ancient prototype, was fast fading away in the distant mist—nature with her sweetened voice and fairy green was dying away in the evanescent vapor of a doubtful reality—the cold, chilly atmosphere of a two miles' height, made me shudder involuntarily; in spite of all my efforts to the contrary my teeth chattered with all the fervor of a cold ague. How changed! in a few moments, from the arena of nature's most gorgeous scenery, I was transferred as it were, into the icy chamber of death. Oneida Lake appeared to be gaping eagerly to receive me in its cold embrace.

Suddenly, I awoke from my revery; I looked around once more, above, below, to earth; I caught hold of the valve rope—soon the vapor was shooting upwards by me; I was falling rapidly into a more congenial climate, and in a few moments more was down in a hemlock clearing, tearing up fences, limbs of trees, &c., until the grapple iron finally took substantial effect in a hemlock stump, about six miles from Syracuse.

CHAPTER XXIV.

Ascent from Auburn, N.Y.—Narrative of its extraordinary magnificence and grandeur—"A speck in the horizon"—Ascent from Buffalo City, N.Y.—Windy weather—View of Niagara Falls from balloon—Disappointment of expectations—Looked like a frothy bubble—Another ascent from Buffalo—Driven out on Lake Erie—Rescued by "brig Eureka," Captain Burnell—"Buffalo Courier" notice of it—Ascents from Rochester—Oswego—One from Washington City, D. C.

On the 24th of July, 1847, I made an ascension from Auburn, a flourishing and beautiful town, situated about twenty-five miles west and a little south of Syracuse, making it a favorable point to reach Syracuse from, by the upper current which always blows from west to east. It was a magnificent voyage, and the main part of the journal is worth a perusal here, to wit:—Up, up I soared, almost perpendicularly, until an altitude of at least a mile and a half was reached, when I began to look around me, and then, great God!—yes, I made the exclamation again as I was sitting with my pencil and log-book in hand riveted to the sight—great God! what a scene of grandeur! Oft have I enjoyed and reveled in the intellectual indulgences of nature's luxuries. Many, many beautiful and magnificent scenes have I witnessed, but this surpasses all. Such were my involuntary exclamations. I looked around again and again, still the reality seemed like a splendid dream—an enchantment—it was too rich a scene to be deprived of, by a short trip. After I had viewed, and reviewed the vast panoramic plain, and wondered at, and admired the handiwork of the Creator—its amplitude and order, I would try to settle my mind down to a cool and descriptive standard, but admiration and amazement had enchained my thoughts alone for nearly one hour, and ejaculations flowed over the glorious spectacle beneath me. The vastness of the scene, extending nearly a hundred miles each way (the atmosphere was very transparent), beautifully interspersed with lakes; the innumerable villages, many of them glittering with silvery domes and spires; the tiny and tastefully decorated prison-house at Auburn; the thousands of variegated grass-plats; the golden tinge of the waving grain fields; the glossy surfaces of the lakes dazzling in the sunbeams; the lights and shadows over the general surface caused by a partly clouded sky; the huge precipices of clouds lying to the east and partly beneath me; the wide mirror-like surface of Lake Ontario, with its fringed southern border; the cities in the evanescent distance decorated with brilliant specks, with a thousand other things, so completely absorbed my mind, that when I looked at my watch I found that I had been aloft one hour and ten minutes.

Looking up at the balloon, I found her discharging gas at the safety valve. Although but half filled when she left the garden at Auburn, the immense machine was now full and distended to the utmost tension, showing that my altitude was over two miles. A cluster of detached clouds was hanging between me and Syracuse some distance off. Here I took another observation of the lakes, and counted thirteen in view—Lake Ontario looked like an immense sea, its northern boundary lost in the distant heavens. After being aloft one hour and a half I found myself crossing Onondaga Lake, having northed too much for Syracuse, and making direct for Liverpool, a village five or six miles above the latter place, near which I made a landing, breaking the Oswego telegraph wires with the grappling iron.

The balance of the account is best told by the Syracuse Journal.

A SPECK IN THE HORIZON.

"When Mr. Wise had determined upon making an ascension from Auburn on Saturday, he assured several of his Syracuse friends that should the weather prove favorable, he would endeavor to pay them a flying visit, and possibly take tea with them on Saturday evening. This was thought a very good joke.

"A few minutes before five o'clock Saturday afternoon, as a number of the more credulous were on the "look out," they thought they espied something far at the southwest that *might* be a balloon. It was no bigger than a man's hand, to be sure, but it moved 'like a thing of life' through vast expanse, guiding itself majestically like some proud

'Lord of the boundless realm,'

and gradually increasing in size as it approached. Ere long, all doubt was at an end. The *balloon* and its voyager were now fairly in view. It was a glorious, a beautiful sight! and thousands in all directions were wrapped up in its admiration. The course of the balloon was to the northeast, and it passed directly over Geddes, thence over Onondaga Lake to Salina, when Mr. Wise began to descend. In lowering his ship, a sub-current of air carried him toward Liverpool, and at thirty-five minutes past five o'clock, he landed on Mr. Waterbury's farm, about six miles from this village. There he was soon met by numerous friends, in carriages, from Syracuse, who had followed his course.

"In making his descension, Mr. Wise still kept the balloon inflated, and soon made his appearance in our streets, seated comfortably in his car, ready for another trip to the 'ether blue.' A farmer's wagon piloted the aeronaut and his apparatus through Salina street to the Syracuse House. Here, as may readily be supposed, a large crowd gathered. Mr. Wise was evidently much pleased with the success of his journey, and the welcome he had received. To gratify curiosity, and at the request of many, he prepared and made an ascension from in front of the Syracuse House about seven and a half, amid the shouts of the crowd. He traveled a short distance west, landing somewhere in the vicinity of Geddes. At half-past eight o'clock he returned to Syracuse, and redeemed the promise to take tea with his friends."

My next ascension was made from Buffalo, and the first successful one that had ever been made from that place, as I was informed.

AERIAL LOG-BOOK OF SIXTY-SECOND VOYAGE.

MEMORANDA.

Buffalo City, Morris' Garden, July 31st, 1847.

Four P. M. precisely, started with aerial ship "Rough and Ready" under ballast and brisk gale from the S. S. W., wind moving at the rate of a mile per minute. Started with considerable ascending power, but the current was so strong, that in order to make a more perpendicular rise thirty pounds of ballast were thrown overboard, which having lightened the vessel, and a strong gale blowing against it as it rose, caused it to pitch and gyrate with a desperate motion, which turned the balloon about one third round in the network, and made the valve partly unmanageable.

My first observation was the place I had left, which was five minutes afterwards. The city, although covering much territory, seemed compressed into an area of a hundred yards square. Lake Erie appeared tapered off to a narrow ragged pond on its eastern extremity, then it diverged into two narrow silvery threads, which re-united again around a small green plat. Upon reflection I concluded this must be Grand Island, and immediately my attention was drawn to a search for Niagara Falls, as I heard a slightly rushing noise of waterfall. My eye soon rested upon it, and after scanning it for a few moments I involuntarily cried out "Is that the falls?" And no wonder, for [illegible] not even [illegible] not [illegible]

it looked like a cascade, such as we see in pleasure gardens. I was disappointed, for my mind had been bent upon a soliloquy on Niagara's raging grandeur, but it was a bubble; it looked too small.

The scenery of the great panorama surrounding it could only absorb my mind. The little frothy bubble had too much the appearance of a foaming glass of London brown stout, and it was insufficient of itself to excite an idea beyond that. It looks like a little humbug when viewed from the clouds. The scenery around was not so pleasing as that presented around Auburn, and Syracuse, and Utica. Here the country appeared dry when viewed away from Lake Erie. A vast plain well wooded, with few roads and less villages, it was altogether of a barren cast.

I made a landing at Williamsville, and was within a few feet of grappling into their church steeple, which might have caused serious consequences to it at the rate the balloon was moving, had it caught into it. This is distant from Buffalo twelve miles.

The Buffalo "Express" says of this experiment:—"The ascension was made under disadvantageous circumstances, but so perfect and so beautiful was it, as to settle in the minds of the people of Buffalo—a large concourse of whom honored the occasion with their presence on the outside of the Garden—the fact that this aeronaut never fails."

A week after this another ascension was made from this place.

AERIAL LOG-BOOK OF SIXTY-THIRD VOYAGE.

Buffalo City, August 6th, 1847.

Left Morris' Garden at precisely six minutes past four o'clock with the aerial ship "Rough and Ready." Wind from the north, balloon rising slowly. Threw over some ballast—men, women and children scrambling out of the way. Ascent became more rapid. Rising, and moving along parallel with Main street—a little east of it. As I rose, the current bore for the lake; began to feel chilly upon the thoughts of a ducking. One mile out on the lake, threw out more ballast to reach the great eastward current. Got up a mile and struck a current at the rate of twenty miles per hour up the lake. This won't do, I shall get out ten or twelve miles before I can reach it, and then probably be blown into Canada, where I would stand a chance of arrest for *contraband*. Opened valve and came down within speaking distance, just over a brig going into Buffalo. "Ahoy, what vessel?" "Brig Eureka, Captain Burnell." "Will you lower a boat, captain, if I come down?" "Certainly, sir," answered Captain Burnell. "Then I'll be down presently." Came down with all dispatch—the brig laid too, but I got astern of her several miles before her boat was lowered, and by that time my car struck the water.

The balloon first rebounded and glanced over the water in a ricochet manner, until sufficient gas was discharged to sink the car some depth in the water. This retarded its progress up the lake and I found the yawl, sent from the brig, was gaining on me. In a half hour longer the boat was alongside and took me in tow. The gas was soon all discharged, and in another half hour I was safely aboard of the brig Eureka, in company with the generous Captain Burnell, who took me into port that evening.

The Buffalo Daily Courier made the following notice of the ascension:—"Yesterday afternoon, according to previous announcement, Mr. Wise made his sixty-third ascension, from Morris' Garden, corner of Main and Tupper streets. Great interest was evinced throughout the length and breadth of the city, to see it. All sorts, sizes and conditions of people were assembled to witness his flight. We were glad to see a good number on the *inside* of the Garden. The *outside*, and indeed the adjacent streets and lanes, were filled with carriages, and a mass of human beings, all anxious to see what they could. After there had been several pioneer balloons sent up, and the curiosity of such as chose to examine the principal one had been satisfied, Mr. Wise prepared himself in the car for his lofty voyage. About four o'clock, after some preliminary trials, he gave the word 'let go,' and amid the cheers and hurrahs of the enthusiastic assemblage, he floated off most grandly. The ease and self-possession which he evinced; the confident air he assumed, showed to our mind conclusively that he was master of his profession. After he was up, he went immediately over the city, in the direction of the lake, thus affording an excellent view of the ascension to the thousands on the housetops, etc."

Ascensions were made from Rochester and Oswego, N. Y., the same summer; both of these trips were of short duration, owing to the proximity of the lakes. In the account of the one from Rochester, the following, in relation to sounds, occurs:—There is but one point of peculiarity in the circumstances of my voyage made on Saturday the 14th of August, which is worthy of particular notice. I have always noticed that certain sounds, produced at the surface of the earth, have a remarkably peculiar effect upon the ear of the aeronaut when immediately over them. Waterfalls are of this kind in their noise. Even a common mill-dam produces a wonderful noise to one's ears when a mile above it. The Genesee Falls made a noise to my ears when above them over a mile, an hundred times louder than did Niagara when I stood upon its brink.

I noticed the same peculiarity, particularly in the returning echo of my own voice, when over Lake Erie. There, the sounds of voice from the persons on board the brig Eureka were remarkably clear and distinct to my ears when immediately over them, but still not so much so, as was the echo sound of my own words. This appeared even louder than the original utterance, and the enunciation quite as distinct. In the case of the words spoken from the brig they became fainter and very indistinct after I got at an angular position from them. From this it appears that the occasional sounds which greet my ears so distinctly when sailing along at great heights, must arise from points immediately underneath me. The same peculiarity holds good in vision. Immediately below one, objects appear very distinct but very diminished from their real size, while at a great angular distance they appear diffused.

In my voyage from Auburn there appeared a very striking phenomenon regarding vision. I noticed in the account of it the lucidness of the atmosphere. But there appeared also a *looming* up of objects in the distance. Lake Erie, which was over a hundred miles off, seemed elevated ten or twelve degrees above the horizon and yet composed part of the visible horizon.

Sound and vision are propagated distinctly in perpendicular lines from the earth's surface;—when heard and viewed in angular directions the resulting effects are diffused in both cases. This I have also noticed in the music when ascending. The tune played by a band of music as I ascended perpendicularly above them was distinct and clear, and when moving off in a rapid horizontal direction, it became very diffuse in a short distance. The firing of cannon, when it is done immediately underneath the balloon, agitates it violently, often with considerable depression in its lower side, but when the firing is at an angular distance, though much nearer than the perpendicular position just mentioned, it is not near so perceptible.

In 1848 I made but one ascension, which took place from Washington City on the 3d of May, of which the "National Intelligencer" makes the following notice:—"In the presence of an immense multitude of spectators, who assembled within the arena and in the grounds and streets contiguous to the City Hall, Mr. Wise, the intrepid and skillful aeronaut, ascended with his splendid balloon about a quarter past five o'clock yesterday afternoon. The aeronaut took a south-easterly direction, and was visible to the naked eye for nearly an hour after the ascension. As he soared aloft, the spectators greeted him with repeated cheers, which he returned by the waving of his hands and handkerchief. It was a beautiful and gratifying spectacle."

PART III.

INSTRUCTIONS IN THE ART OF MAKING BALLOONS, PARACHUTES, AND ALL KINDS OF AERONAUTIC MACHINERY.

ALSO,

DIRECTIONS IN THE PROCESSES OF INFLATION AND PRACTICE OF AIR SAILING.

CHAPTER I.

Introduction—Atmosphere considered as a balloon medium—Cause of failures in small experiments—Table of surfaces, capacities, and powers of balloons—Metal balloons—Materials for experimental balloons—Hints for varnishing silk or muslin for balloons.

When we are about to construct a thing, it is always necessary, in order to be the more perfect therein, that we should know what it is for, and in what manner it is to be used. Then, as balloons are intended to sail in the air, and must therefore be adapted to that element, it will be proper first to learn the nature and buoyancy of the atmosphere. This element surrounds our globe as one vast ocean of about forty miles in depth, as is theoretically assumed. Its pressure on the surface of the earth is equal to about fifteen pounds for every square inch, which will balance a column of quicksilver of two and a half feet in height, and a column of water of thirty-four feet in height, at the level of the sea. Its specific gravity is one ounce and two-tenths per cubic foot, and thus, if we make a body of any material, of the size of a cubic foot, which shall weigh *less* than one ounce and two-tenths, it will float in the air and rise up in it, but it will not, as in the case of water, rise to the surface, for the reason that the atmosphere grows gradually thinner, and of course specifically lighter, as you ascend in it, therefore, the body, which was lighter than an equal bulk of air at the surface of the earth, will just rise to the height in the air where it becomes equal to it in specific gravity. The atmosphere being an *elastic* body, differing in this respect from water as a resisting medium, may be properly illustrated by layers of wool piled upon each other, in which case the lower layer would, of course, be most compressed, while each succeeding layer above would be less and less compressed, as is the case with the layers of atmosphere. And every elastic substance on the earth partakes of this same property as it happens to be placed in the different regions of the atmosphere. Even the human body expands when elevated in the air, and an old wrinkled man will grow full and plump as a youth, if he ascends two or three miles high with a balloon.

By observation and calculation it has been ascertained that at the height of three and a half miles the air is but one-half as dense as at the level of the earth, at seven miles only a fourth, at ten and a half only an eighth, at fourteen only a sixteenth, and at seventeen and a half miles only one-thirty-second of the density it is at the level of the earth. From this it will be seen that we must be kept within the reasonable range of about three miles from the surface of the earth, in aerial navigation.

If the great ocean bed of the sea were to be emptied, and we were to operate with balloons from its bottom level, they would be required of only one-half the size we have them here, to do the same amount of lifting up, computing the depth of the ocean at three and a half miles.

But computing the atmosphere at what it really is where we enter it with balloons, at one and two-tenth ounces per cubic foot, and it does not vary much from this for the first mile of height, it will be seen that we may make our machines of very substantial material, if we make them but large enough, since the cubic contents of globular bodies, or those approaching that form, increase much faster than their superficies. In estimating the ascensive power of balloons, which are to be inflated with hydrogen gas, we may safely calculate upon one ounce of ascensive power for every cubic foot of capacity. With but ordinary care, in generating hydrogen gas, we get more, but it is always best to keep on the safe side of the exact estimates. And here I would remark, that there is nothing connected with aerostatics, that has so much discouraged experimentalists who were trying it on a small scale, as the difficulty in succeeding with the ascension of small balloons, where, if they had tried it with some of a larger size, they would, in all probability, have gone *on* rejoicing. The most of these experiments have been attempted with balloons of from two, three, to five feet capacity, and of course requiring them to be not more than so many ounces in weight when the fuel was in them, and then requiring at that a high degree of rarefaction to enable them to rise, so that in most cases these ends were not attained, on account of the machine being heavier than the air it displaced, and the consequence was a failure of the desired result, and an abandonment of its further investigation, all for the want of properly understanding its first principles, which are so plain and simple that a child may understand them. A chapter to the construction and sending up of toy balloons will be specially given in another part of this work.

The following table exhibits the diameters, surfaces, capacities, and ascensive powers of balloons computed at one ounce of power for every foot capacity, so that, if carburetted hydrogen, or coal gas is used, allowance must be made accordingly. The minute fractions of feet and ounces will not be noticed, as they are of no consequence in the mere practice of the art. The surfaces may be converted into square yards by dividing them by 9.

Feet diameter.	Surfaces in square feet.	Capacities in cubic feet.	Pounds ascensive power.
1	$3\frac{1}{10}$	$0\frac{1}{2}$	$0\frac{1}{32}$
2	$12\frac{1}{2}$	4	$0\frac{1}{4}$
3	28	14	1*
4	50	33	2
5	78	65	4
6	113	113	7
7	154	179	11
8	201	268	17
9	254	381	24
10	314	523	33
11	380	697	44
12	452	905	57
13	531	1,150	72
14	616	1,437	90
15	707	1,767	110
16	804	2,145	134
17	908	2,572	161
18	1,018	3,054	191
19	1,134	3,591	224
20	1,257	4,189	261
21	1,385	4,849	302
22	1,520	5,575	348
23	1,662	6,371	398
24	1,810	7,238	452
25	1,963	8,181	511
26	2,124	9,203	575
27	2,290	10,306	644
28	2,463	11,494	718
29	2,642	12,770	798

* Nearly a pound.

Feet diameter.	Surfaces in square feet.	Capacities in cubic feet.	Pounds ascensive power.
30	2,827	14,137	884
31	3,019	15,598	975
32	3,217	17,157	1,072
33	3,421	18,817	1,176
34	3,632	20,580	1,286
35	3,848	22,449	1,403
36	4,072	24,429	1,527
37	4,301	26,522	1,658
38	4,536	28,731	1,796
39	4,778	31,060	1,942
40	5,026	33,510	2,094
45	6,362	47,713	2,982
50	7,854	65,450	4,091
55	9,503	87,114	5,445
60	11,310	113,098	7,069
65	13,273	143,794	8,987
70	15,394	179,595	11,225
75	17,671	220,804	13,800
80	20,106	268,083	16,755
85	22,698	321,556	20,097
90	25,447	381,704	23,856
95	28,353	448,922	28,058
100	31,416	523,599	32,725
200	125,664	4,188,792	261,800
400	502,656	33,510,336	2,094,400
800	2,010,624	268,082,688	16,755,200

The great advantage in enlarging balloons arises from the fact that their powers increase faster than their surfaces. When you double the diameter of one, you require four times as much silk to make it, but you get eight times as much capacity, and consequently eight times as much power; therefore, whenever you double the capacity of a balloon you save fifty per cent. in its construction, compared with the ratio of its power. And there is another advantage in the enlargement of balloons—we need not confine ourselves to frail fabric for their construction, for, at a very moderate size, we can use copper or iron to make them of. If we use copper in the construction of a balloon of two hundred feet diameter, which weighs one pound per square foot, and deduct this from its ascensive power, we shall have remaining sixty-eight tons of lifting power; and if we allow room for expansion of gas for an altitude of about two miles, and allow five or six tons for the car and its fastenings, we will have left a lifting and carrying power of about forty-five tons. To inflate a metal balloon, if it were made not to be susceptible of collapsing, it would be necessary to insert a muslin balloon in it, filled with atmospheric air, and the hydrogen gas passed in between the muslin and copper surfaces, which would exclude the inner balloon as the copper one would fill up. A copper balloon's ascent and descent would have to be regulated by a drag rope, on Mr. Green's plan, and the expansion and contraction of the gas in it would have to be provided for by an elastic diaphragm, and an opening in the bottom of the machine to communicate between the diaphragm and the atmosphere.

But our object for the present must be to instruct in the art as it is, and those plans of a larger scale will soon follow in the wake, when the genius of our country is once properly awakened to its importance.

We can easily operate with balloons of one hundred feet diameter, made of silk or twilled muslin, and one of such capacity has a power of about ten tons, independent of appendages, and room for expansion of gas.

Having now before us the calculations of size and powers of balloons, the next consideration will be the material of which they may be made. For balloons, for experimental purposes, to make ascensions with, and under a capacity of thirty feet diameter, silk or cambric muslin is generally used. Although cambric muslin makes a very good machine, and costs a trifle less per square yard than Indian silk, still, silk is the cheapest in the long run. Any pliable silk will answer the purpose; but the India silks are the most economical and durable for balloons. India sarcenet makes a very light machine; but the India tassore is the kind I have preferred when not wishing to use the pongee, which is dearer. The tassore is made from the product of the wild silkworm, which browses on the shrubbery in the fields, and is the strongest article I have ever found for balloons, in proportion to its weight; and it is the cheapest silk per square yard of any that comes to our market. I have never yet had any difficulty on account of durableness, in strength, or in the imperviousness of the machine, while using one made of this kind of silk. It is imported in twelve yard pieces, and varies in width from thirty-four inches wide to forty. Sometimes it is strongly stiffened or dressed with a starch made of rice and urine, which it is best to take out by rubbing the silk between the hands, when it will fall out in a fine dust resembling flour.

Thus prepared, the silk is next to be coated with varnish. The first coating may be put on by soaking the silk in warm varnish, and leveling it nicely over with a palate knife or smooth spatula after it is stretched out on frames, or hung up by its edge. I have always, however, preferred the brush to lay the varnish on with, and the thinner the coatings were put on, the better it turned out in the end. I find that the same weight or quantity of varnish put on in four layers, that is, in four coatings, will make the silk a great deal more air-tight, than when put on in only two layers or coatings. This is easily accounted for. Varnish membranes or coats, like all other membranaceous substances, are vascular and porous, and, by dividing the quantity spread over any surface into many layers, you obstruct the pores of the one by the laying on of the next. The pores of the second coat not coming exactly over the pores of the first, and so with the third coating in regard to the second, and so on. This holds good in silk or muslin.

CHAPTER II.

Of oils—Tests—Table of specific gravity of oils—Preparation of author's invented balloon varnish—Varnish for recoating balloons—Bird-lime varnish—To make bird-lime—Caoutchouc, or gum-elastic—Caoutchoucine.

The greatest difficulty I had to overcome in the practice of ballooning, was the invention of a good varnish for coating the material of the balloon. I have before stated the vexations and dangers that attended the use of gum-elastic varnish, and, although I shall not recommend it as a substance well adapted to balloon varnish, I will not condemn it. I have my doubts, however, whether it contains in any form or preparation as used for a varnish, the unchangeably elastic property which is found to exist in linseed oil when properly prepared. At all events, I have never found gum-elastic varnish to attain a drying property without the addition of metallic oxides in its composition. These oxides have a strong affinity for heat (oxygen), thereby being liable to fermentation and spontaneous combustion—the very plague-spots in aeronautics. There is perhaps nothing so commonly used as linseed oil, about which there is, chemically or experimentally, so little known. Even the oil itself is not very well known by those who use it. Other oils are frequently sold for linseed oil, and as often used for it, by those who are in the habit of its daily use.

It will, therefore, be well to lay down the tests for the various kinds of oil first. By this the student will know how to avoid, in the beginning, that which might cause him perplexity and failure in the end.

OIL TEST.

Doctor Ure says: M. Heidenreich has found, in the application of a few drops of sulphuric acid to a film of oil, upon a glass plate, a means of ascertaining its purity. The glass plate should be laid upon a sheet of white paper, and a drop of the acid let fall on the middle of ten drops of the oil to be tried.

With the *oil of rape-seed* and *turnip-seed*, a greenish-blue ring is gradually formed at a certain distance from the acid, and some yellowish-brown bands proceed from the centre.

With the *oil of black mustard*, in double the above quantity, also a bluish-green color.

With *whale and cod oil*, a peculiar centrifugal motion, then a red color, increasing gradually in intensity; and after some time, it becomes violet on the edges.

With *oil of cameline*, a red color, passing into bright yellow.

Olive oil, pale yellow, into yellowish green.

Oil of poppies and sweet almonds, canary yellow, passing into an opaque yellow.

Oil of linseed, a brown magna, becoming black.

Of *tallow* or *oleine*, a brown color.

In testing oils, a sample of the oil imagined to be present should be placed alongside of the actual oil, and both be compared in their reaction with the acid. A good way of approximating to the knowledge of an oil is by heating it, when its peculiar odor becomes more sensible.

Specific gravity is also a good criterion. The following table is given by M. Heidenreich:—

	Sp. gr.
Oleine, or tallow oil . . .	0.9003
Oil of turnip-seed . . .	0.9128
Rape oil	0.9136
Olive oil	0.9176
Purified whale oil	0.9231
Oil of poppies	0.9243
Oil of camelina	0.9252
Linseed oil	0.9347
Castor oil	0.9611

It will be seen that linseed oil is the heaviest in the list except the castor oil.

PREPARATION OF BALLOON VARNISH.

Take pure linseed oil, as much as will fill half the vessel, and not over, and put it over a fire. Let it heat gradually up to a degree at which it will char wood. Before it arrives at that heat, it will show symptoms of boiling, which is, however, nothing more than the boiling of the small quantity of water that is generally in solution with the oil. Before the oil begins to boil, it must be brought to a much greater heat, and, as before stated, to that degree at which a piece of wood immersed in it will be quickly carbonized. At this point, it will have to be closely watched, for soon it will commence an intensely heated reaction, beginning to foam and emit dense vapor, when, if not well secured from the air, it will soon burst out in a flame. By using a boiler with a close cover, which has a very small air-hole in it, the operation may be continued briskly for at least an hour, and if not kept up so briskly, for two hours or more. The best way to tell when it is boiled enough, is to take out a little with a spatula occasionally, and putting it on a piece of glass or tin to cool, when it will be found thick and very stringy, when sufficiently done. It will also be of a deep reddish color when done. If the oil is of a good quality and well boiled, or we might rather say decomposed in this way, it gets very thick when cooled, and in appearance very much resembles Indian rubber, and in elasticity superior to it. Its nature becomes entirely changed, as the fatty adhesive property of it seems to be destroyed in it. After being prepared in this way, it should be stood in the light for a while, when it will settle, separating the pure portion by its floating above the black carbonaceous matter at the bottom. Before using it, it must be thinned with spirits of turpentine, and this should be highly rectified in order to make the varnish dry readily. This varnish will dry in the sun in five or six hours, and requires no *driers* of metallic oxides to facilitate its progress.

Silk or muslin, when coated with this valuable preparation, possesses the peculiar property of being a *non-conductor* of heat, instead of the dangerous property pertaining to most oil varnishes, of contracting heat (affinity for oxygen). Balloons prepared with this varnish have been suffered to remain packed up in a chest for months without the slightest development of heat or adhesiveness—a difficulty which cost me more perplexity the first five years of ballooning than all other obstacles put together.

This varnish improves by keeping, and if kept in a glass vessel it will improve and become clear faster than when kept in a vessel where the light is shut from it. By keeping it for three or four hours in an intense heat when preparing it in the boiler, it will upon cooling get almost as solid as Indian rubber. It may be diluted with turpentine as soon as sufficiently cooled down to bear it when first prepared, or it may be partly warmed, when it has been suffered to cool and settle after being prepared without having been thinned at the time.

This varnish does not dry so well in the shade, and, as it becomes necessary to varnish a balloon sometimes after it is made, which is generally done in a room, the following preparation will be found to answer the purpose very well:—

Take umber made fine two ounces, common yellow ochre four ounces, and litharge one ounce, to half a gallon of the above-mentioned varnish, and boil them well together for half an hour. This will dry very rapidly in the shade or the sun, and should be used very thin for re-coating. A half gallon of it can be diluted with turpentine so as to be sufficient to coat over a balloon of twenty-five feet diameter, if made of silk. Cotton ones take a little more.

Having now given what I deem to be the best composition for coating hydrogen balloons, it will not be improper to mention such others as may be used.

BIRD-LIME VARNISH.

This makes a very good balloon varnish, and is composed in the following manner: Take bird-lime four pounds; boiled oil four pounds. Boil these together until they are perfectly incorporated, then add six pounds more of boiled oil, and one pound of litharge (oxide of lead); boil again until the whole mass becomes well intermixed and stringy; this can be ascertained by occasionally taking a little out with a spatula and putting it on glass or tin and trying it. When done and partly cooled off, add to this quantity about three quarts of turpentine and let it settle, when it is ready for use. This varnish dries very readily in the sun, and should be applied lukewarm.

As bird-lime is an article rarely found in this country, it will be proper to state how it is made: Take the middle bark of the white holly in any quantity; boil it for seven or eight hours in water, or until it gets soft; then drain off the water and place it in a pit three or four feet deep in the ground, and surround it with stones; let it remain in this place until it passes by fermentation into a mucilaginous state; then take it out and pound it, or run it through a crushing mill; after this wash it in several waters, then take it out and let it ferment four or five days to purify itself.

As gum-elastic has been recommended for balloon varnish, as well as the first hydrogen balloon having been coated with a solution of it, we will here give what knowledge we have of it.

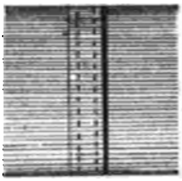
CAOUTCHOUC, OR GUM-ELASTIC.

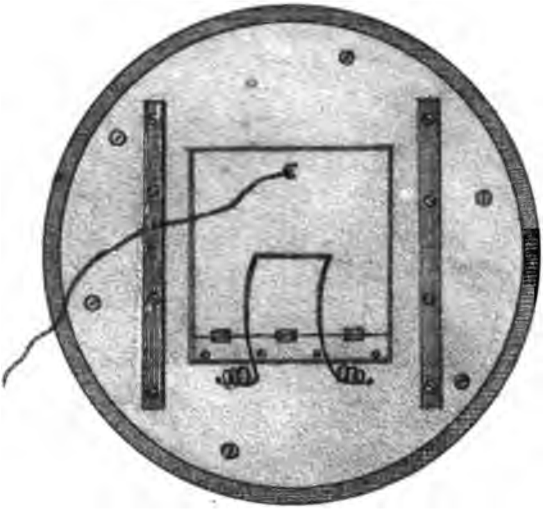
This substance exudes from certain plants when incisions are made into them, in a milky-like fluid state, and congeals when left exposed long to the atmosphere, and when hardened in this manner is of a lightish-yellow color. It is generally imported from South America, and that which we get in the shape of shoes and bottles is of a blackish-brown color, which it acquires from being dried in smoky places. It is remarkable for its elasticity, from whence proceeds its popular name. It is soluble in various oils, such as cajeput, sassafras, and naphtha, but its most common solvent is spirits of turpentine. When dissolved in any of these substances and used as a varnish, it never regains its former elasticity, but it is said to recover its elasticity when precipitated from cajeput oil by alcohol.

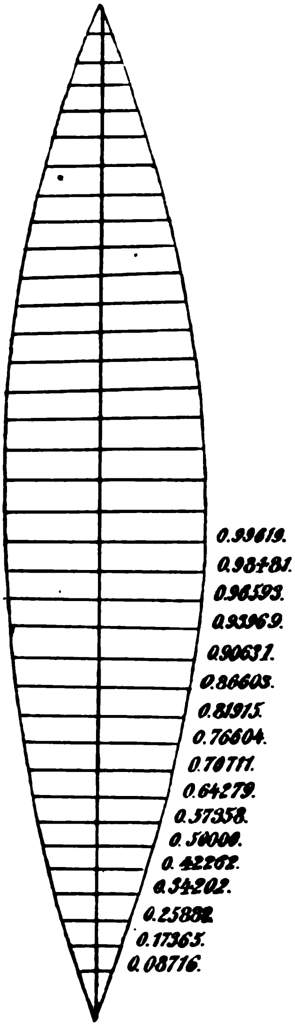
I believe it would dissolve in very high pressure steam, as it has been so softened by steam of four atmospheres, as readily to yield under the palate knife. By proper distillation it yields a volatile liquid of the specific gravity of 0.64, which is extremely light! To this substance chemistry has assigned the name of *caoutchoucine.* It is perfectly limpid, and it is said to be a perfect solvent for the gum it is made of. And it is also stated, that Indian rubber, or as it is also called, gum-elastic, dissolved in this liquid and applied as a varnish, will recover its original elasticity. With this I have not yet tried experiments in coating balloons, because the linseed oil preparation answers the purpose so well, but I have no doubt this *caoutchoucine* preparation would be very good, if it would not be too expensive.

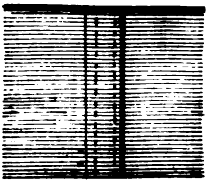
There are many other preparations recommended in receipt books for coating balloons with, but none that I would recommend the experimentalist in aerial machinery to have anything to do with. The application of metal leaf, such as Prince's metal, Dutch gold, and others, I have found to do very well in making aerial vessels tight, when applied before the varnish has been quite dry; but these are too expensive for large balloons. They answer an admirable purpose for small ornamental balloons, or any kind of aerostatic figures.

Seam.









Seam.

P.S.Duval's Steam lith. Press.

INSIDE VIEW OF THE VALVE.

CHAPTER III.

Scale to shape balloons—How to make a pattern—How to cut material economically—Pear-shape—Diameter to circumference—Seams, how joined—Filling it with common air—Neck of balloon—Test of balloon—Valve, how made—Net, how made—Rigging and car.

Balloons are generally made of a globular shape, or approximating to it. The following scale will answer to form the segments for a balloon of globular shape, no matter what the width of the material is of which it is to be made. The piece intended for a pattern segment has a line drawn through its middle in length, and one across the middle. This will divide it into four quarters. One quarter is divided by seventeen cross lines at equal distances apart, making eighteen parts of the quarter section. Now whatever the breadth of this half segment may be, it is to be multiplied by the logarithms in the scale, which will give the length of the line of each division, where the curve line is to intersect it. These points once secured, it is easy to draw the curve line with a steady hand. I have generally made a board pattern, as I could by it cut one or more segments at a time, by running a sharp knife round the edge of it.

In making my scale for a pattern, I merely use a strip of wood which in length is equal to the half breadth of the segment, being the length of the lower line from the centre to the edge. This I divide into ten parts, each part into ten more, thus making tenths and hundredths, which answers all practical purposes. Now for the length of the first line it will take eighty-seven-hundredths full, for the second line, one-tenth, seventy-three-hundredths a little full, for the third line, two-tenths, fifty-hundredths full, and so on. Such a scale can be made very easily with common dividers.

To cut and use the material the most economically, the balloon should be made pear shaped, which is a very good form. In doing so, the pieces which are cut from the sides of a piece that is two-thirds the length of a segment, will make the lower third of it by sewing their straight edges together and butting it on the other. This will make the central, or equatorial part of the balloon, cylindrical for six or eight feet. For a common experimental balloon, capable of carrying a man and all necessary appendages I have preferred the shape made by cutting the segments from a scale calculated for twenty-four feet diameter, and putting in as many segments as would make the machine only twenty-one feet in its transverse diameter, and twenty-two yards, or sixty-six feet round its equator, since the circumference to the diameter is as twenty-two to twenty-one, gaining one foot in the circumference for every seven feet diameter, over and above three times the diameter. This is a mathematical truth balloon makers must not overlook. Making them on this scale elongates the balloons from top to bottom somewhat, and makes them of a longish pear shape—a form I have found very favorable to manage in merely experimental operations.

After the varnished material has been properly prepared and cut out, the next process will be to sew it together. This can be done by any seamstress who possesses ordinary ingenuity; but at first will come a little awkward on account of its being an unusual kind of material to sew at. The edges are made to overlap each other about three-eights or a half an inch, and sewed with a common running stitch, as represented in the cut.

SEAM.

After the seam or seams are sewed they must be coated over on both sides with a drying varnish. One part of drying copal varnish and one part balloon varnish mixed make a very good composition for this purpose. This stops up the needle holes and insinuates itself between the lap of the seam and consolidates it, which also gives the balloon strength, by forming a sort of rib work in it. Many seams in a balloon, made in this manner, are beneficial to it, because it gives it superior strength; and when they are neatly done, without puckering, they add to its beauty. In joining the segments, care must be taken to bring them out in equal length, as any material variation from this would destroy its mathematical figure, and impair its symmetry and strength.

In cutting out the segments, allowance must be made in their lower ends, so that when the balloon is sewed together it will have an open neck of eighteen inches diameter, which will admit a man's body, as it is necessary to go inside of the balloon in arranging the valve and its cord, as also to examine the perfection of the machine. By using the strips which are cut from the sides of the upper half of the segment for the lower part of the balloon, the neck will be handsomely shaped from them. When the balloon is completely sewed together it should be blown up, which is easily done by placing a hoop in the neck to keep it open, and then driving air into it with a common palm leaf fan, or a good feather fan, and left for a day or two to see how it holds the air. As it holds common air, so it will hold hydrogen, with the odds in favor of hydrogen. About the diffusion and affinity of gases, something will be said hereafter. If the balloon seems not tight enough upon such trial, the application of a very thin coat of varnish, as prescribed in the article of balloon varnish, will be found to produce a very beneficial effect. I have generally coated the material three times before sewing it together, and after being joined, coated the seams well, and then used the balloon for one voyage, after which I gave it a complete coat of varnish, when it could be used for eight or ten voyages before it wanted recoating. The heaviest glazed side should be inwards, as there may by carelessness in the process of inflation some fumes of the heated acid pass into the balloon.

When the balloon is formed, it wants a valve placed in its top, and if it is desired to have more than one, others may be placed in its side, about or above the centre. In common balloons I have found one amply sufficient, as it can be made large or small to suit the fancy of the aeronaut. Indeed, I never used a balloon with more than one valve in it; but Mr. Green of London has several in his large Nassau Balloon, as I have been informed. In so large a machine it may be highly necessary.

In balloons of from twenty to twenty-five feet diameter, I have used valves of the following dimensions and construction:—Two disks of wood one foot in diameter, and each three eighths of an inch in thickness, are smoothly leveled off. On their inside surfaces are glued a layer of sheep-skin leather, so that the leather projects half an inch over the outer edge of the disk: this is to protect the silk or muslin of the balloon from the more harsh edge of wood. When the disks are thus prepared, they should be screwed together with five-eighths inch wood screws. Then a hole four inches square is cut through the centre of it.

VALVE.

The clapper, which is four and a half inches square, so that it overlaps the opening a quarter of an inch all around, is covered with strong pliable sheep-skin leather, which should project about half an inch at the hinder edge to answer for the hinge of the clapper, and by which it is tacked down to the disk. In place of this, however, light brass hinges may be used, just as the mechanic fancies. In the rear of the clapper is inserted a wire coil spring which curves over and on the clapper, touching it a little behind its middle, and pressing on it to an extent of several pounds at least, making it *self-shutting*, since the pressure of the gas against it means nothing, as is otherwise supposed it does. This kind of spring is used in the common spring mouse-trap, as also in locomotive engine pipes at their joints to let them down by, from which the idea of it will be properly presented. I have used various other kinds of springs, but none answered so well as the kind here described.

When the valve is made, one disk is placed inside the balloon at its top centre, and the other disk on the corresponding outside, and thus screwed together, clasping the silk, which ought to be doubled for a yard or so at the top, between. The piece in the opening part of the valve is then cut out, so that when the clapper is drawn open a free communication is opened for the gas to escape. On the inside of the valve clapper a wire ring is screwed or clinched, from which the valve rope proceeds down through the neck of the balloon into the aeronaut's car.

On the outside of the valve disk several small rings may be screwed to which the net may be fastened with slight twine to keep it to its place while the balloon is being inflated. This fastening should not be too strong, as the net would bring an unequal stress upon that point of the machine in case it should have slipped from its centre, if they were too strong to resist its accommodating itself to the weight below which regulates its disposition over the surface of the balloon.

Spanish cedar I found to be the best wood for valve disks and clappers. It is light, substantial, and unchangeable, when properly seasoned; and it is a wood that is easily worked. On the inner side of the disk two ledges, each three-eighths of an inch thick and three-fourths of an inch wide, should be screwed on, a little on each side of the clapper. This will keep the disk from warping, and the surfaces level and gas tight between the clapper and disk.

NET-WORK OF BALLOON.

When the balloon is made and its valve properly inserted, it wants a net-work to cover it over for the purpose of distributing the power it is to produce over its surface equally. This may be composed of any sort of twine. Silk makes the lightest and best; but I have always used a cotton twine as being in every way well adapted to the purpose. It is soft and elastic, and can be procured from the rope and twine sellers of any required strength. The weight, or strength of the twine governs the size of the meshes of the net. If a light twine is used the meshes should be smaller than for a heavier kind. The last two nets I made were of cotton twine, having thirty-six threads in it. It was about the tenth of an inch in thickness. The meshes were of three different sizes; commencing from the centre of the net, they were knit over a five-inch board, which makes a mesh ten inches long when drawn its full length, and five inches square when opened. This size meshes were continued for one-third the distance of the net from the centre to its lower edge; from this point the meshes were made over a six-inch board for the next third; and from this they were made over a seven-inch board for the balance of its required size. The size of the net is to be so regulated that the meshes will assume an oblong shape over the upper surface of the balloon. They should stand twice as long as broad when the net bears its burden. At its lower part the meshes should become more oblong, for which the allowance must be made accordingly.

For beginning a balloon net, a round block or board about eight inches in diameter, with its edge slightly grooved, answers a good purpose. Around this groove a quarter-inch cord is to be spliced. Before this cord is put on, there should be as many curfs cut in the edge of the block as it will require loops to begin on. At each of these curfs a loop is to be made for the beginning of the net, the last loop having its end for the beginning of the knitting process, from which it can be knit round and round to the required size. Its increase of size is made by throwing in *half-meshes*, and these must be regulated according to the mathematical increase of the balloon, which the common arithmetician can calculate by the increased size of his pattern segment.

The net should come down some distance below the equator of the balloon, and ought to cover two-thirds of the machine, but half-covered may do. This embraces the fair mathematical process of construction, but a net is of such an accommodating and elastic nature, that almost any form or shape will answer, provided it is big enough. It may be begun by simply knitting a square piece of the size of a yard, and then commence knitting around and increasing it according to the size of the balloon it is to cover. I saw one knit in this way by Mr. Paullin, which answered the purpose very well, but the first directions are the best, and will recommend themselves from their simplicity and comprehensiveness. A much lighter twine may be used than above stated by making the meshes smaller, but in that I have experienced a difficulty in the part of the net where the main cords were attached to it, in landing in strong winds, by its tearing, although more strands were fastened to the main cord; while with the heavy twine in the net I never had a single strand of it broken, though branches were torn from trees and fences pulled down in the progress of the balloon's landing, all of which force came upon the netting.

From the lower edge of the net proceeds the cords to which the car of the aeronaut is suspended. For a twenty-two feet diameter balloon twenty attachments are sufficient. ~~These~~ attachments converge into one joining six or eight feet below the net, which will make but ten main cords to come down to the concentrating hoop, at which point the connection of the car to the net should be made. This I have always done by simply tying the ropes together, but the aeronaut may use his own fancy for that. The concentrating hoop should be at least six feet below the lower extremity of the balloon, when it is all rigged. From the concentrating hoop down to the balustrade hoop twenty cords proceed, and these should be worked in with the wicker work of the car, going clear down its side, across the bottom and up the other side, in order to make the car perfectly secure in its bottom.

The tying, splicing and joining of the various cords, may all be done according to the operator's particular taste and fancy. Much ingenuity and ornament may be exercised, as is the case in the French aerial machinery. Solidity and safety should, however, be the main point of consideration.

CHAPTER IV.

Weight of Hydrogen—Vitriolic process of inflation—Strength of sulphuric acid—Apparatus illustrated—Balloon, how kept under process of inflation—Pure hydrogen process of inflation—Carburetted hydrogen for balloons—Its consideration in the future prospects of aeronautics.

After the balloon is made and properly rigged, it is ready for actual service; but in order to make it useful it must be inflated with a substance lighter than atmospheric air. The lightest of all ponderable substances, that we have any knowledge of, is pure hydrogen gas. This gas exists as an elementary component part of almost every substance in the world, and particularly in matter of a combustible nature. In most cases it is evolved, compounded with other gases, particularly from bituminous coal, when it is mixed with carbon—generally termed *vapor of carbon.* From this it can be separated and purified by passing it through porcelain or earthen tubes heated white hot, where it deposits its carbon. The most ready means of procuring it pure is by the decomposition of water, of which it is a constituent. The gaseous combination of water consists of ~~nine~~ atoms of oxygen and one atom eight of hydrogen. The one atom of hydrogen is twice the bulk in size of the nine atoms of oxygen when liberated in their gaseous states. Hydrogen is sixteen times lighter than oxygen, and over fourteen times lighter than common air. Thus, if we use pure hydrogen for ascending power, we shall have full thirteen-fourteenths of the atmosphere's buoyancy, which would be seventy pounds for every thousand cubic feet of gas in the balloon. But in generating hydrogen by decomposing water with oil of vitriol and iron or zinc, it is liable to impurities, so that we get only from sixty to sixty-five pounds to the thousand cubic feet. But by decomposing water in passing its steam or vapor through heated iron turnings, we get the hydrogen pure, and an ascending power of seventy pounds for every thousand feet. And so we will by passing coal-gas (carburetted hydrogen) through heated porcelain or earthen tubes in which it deposits its carbon, and is consequently purified.

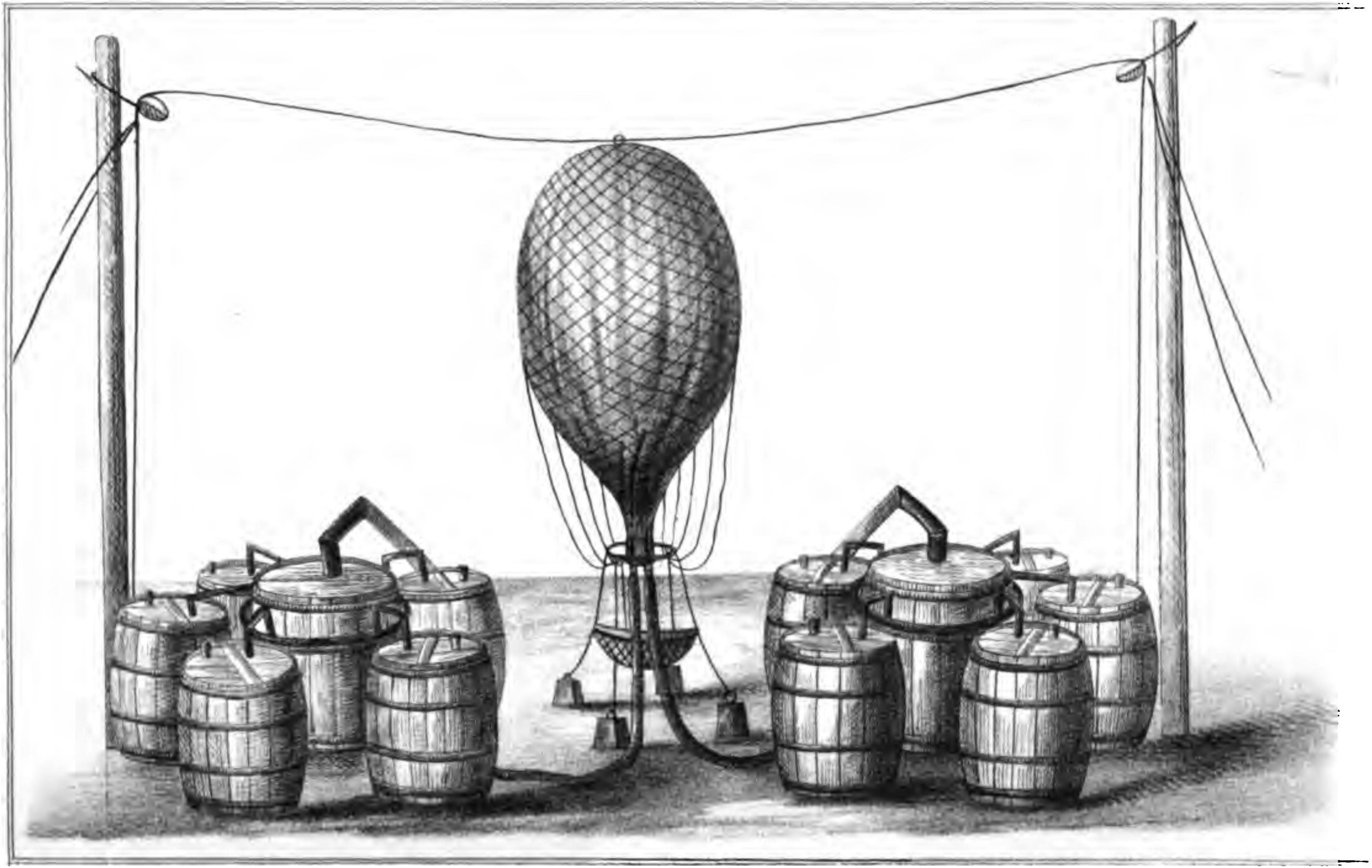
VITRIOLIC PROCESS OF INFLATION.

The readiest means for procuring a large quantity of hydrogen gas in a short time, is by the vitriolic process. With eight or nine common rum puncheons of 130 gallons each, for retorts as gas generators, 5,000 cubic feet of hydrogen can be evolved in one hour. To effect this with eight casks—air tight ones—each one must contain seventy gallons of clear water, and 125 pounds of iron in the shape of turnings, or borings of clean cast iron, or card teeth, or fine particles in any shape, and if nails or other heavy scraps are used it will require more in proportion, since the time of oxidation is according to the *surface* presented by the iron to the acid. Into each of these casks 144 pounds of oil of vitriol of the specific gravity of 1.85, which is the common strength, must be poured at once, which in one hour will produce 600 cubic feet, or more, of hydrogen gas. The proportions in weight are as follows:—Water 560 pounds; oil of vitriol 144 pounds; iron turnings 125 pounds. In operating on a small scale, the formula is:—Vitriol one pound; iron one pound; water four pounds, which will produce four cubic feet of hydrogen. In the arrangement with the eight casks they may be all put in operation at once, or only a part of them at a time, just as the operator may prefer, or as his arrangements for cooling and washing the gas may permit. It should be run through a head of water of eight or ten inches, supplied with ice, and if ice can not be procured, a running stream of cool water passing through the cooling tub will answer equally well. There should be a peck of lime dissolved in the water of the cooling tub to absorb any carbonic acid gas that may be generated, as this gas is heavier than atmospheric air.

This process takes place under the law of chemical affinities. The water being composed of oxygen and hydrogen in *liquid* combination, these must be separated and rendered *gaseous*—at least the hydrogen, which we want, must be rendered so. Iron exposed to water extracts from it the oxygen without any other agent, but this is greatly facilitated by adding sulphuric acid, or, as it is commonly called, oil of vitriol. This acid is formed of water highly impregnated with oxygen, and it has a powerful effect in separating the atoms of which iron is composed, when water is present to supply oxygen to unite with the atoms of the dissolving iron. Now the oxygen of the water having a stronger attraction or affinity for the atoms of iron than it has for the hydrogen with which it is associated, it leaves the latter and incorporates with the former, and the hydrogen is set free, as is also the caloric of *fluidity*. The iron and sulphuric acid mingle with the undecomposed water in the retort, and the hydrogen passes off through the tubes and up through water, into the balloon—the caloric is absorbed and diffused, the greater portion of it neutralized in the cooling tub.

In testing sulphuric acid, it is compared in its weight to that of water. Good sulphuric acid is nearly twice as heavy as water. As, for instance, a certain *measure* of water will weigh 100 grains, an equal *measure* of good sulphuric acid will weigh 185 grains—this is its officinal strength, and when weaker than this it is not well adapted to the evolution of pure hydrogen by decomposition of water.

The apparatus as shown in the plate is the kind I have always used. The casks may be arranged in one or two sets. The number of casks used as retorts, can be varied according to size. If they hold but sixty-five gallons a piece, sixteen can be used, and even barrels can be used, if only the number is increased in proportion to the diminution of their capacities. For the larger kind of casks two inch tin tubes are sufficient to pass the gas from the retorts to the cooling tub. The cooling tub should hold at least 150 gallons of water, and of a shape which will receive a common sized hogshead with its *under* end open, into it, with space enough between it and the inside of the tub for the gas pipe to pass down between them, and its recurve terminate under the inverted hogshead, or gasometer as it is called. These gas tubes should have flanches half an inch from the end which goes in the head of the retort, by which they may be securely tacked down with 16 oz. tacks, with putty under the flanch to make an air-tight joint. The tube which passes the gas from



P. S. Duval's Steam lith. Press.

INFLATION OF BALLOON.

the cooling tub or gasometer to the balloon is also to be made of tin, and with a flanch, but of four inches diameter. From this main tube to the balloon the gas passes through a hose made of stout muslin rendered air tight with balloon varnish, and the connection at the entrance of the balloon is made by a short four inch tin tube.

While the balloon is under the process of inflation, it can be handily kept to its place by the net cords being fastened to weights. Although I have always commenced the inflation with the balloon lying on the ground, I do not hesitate to recommend the plan of hanging it up as represented in the plate, since by such plan the net can be more easily adjusted and kept to its proper centre, than by the other. There should be extra ropes proceeding from the net by which the balloon is held down during its inflation, so that the car may be harnessed to the rigging without disturbing the weights which hold it down, and these should only be loosened when everything is ready for a start.

PURE HYDROGEN PROCESS.

This is done by passing steam through iron turnings, heated red hot in iron cylinders or retorts. Such an apparatus would be more economical than the one just described, for a stationary one, and where continuous quantities were required. The retorts must be made of heavy cast iron, three quarters of an inch in thickness, and of ten or twelve inch calibre, and about eight feet long. Three of these, set in a furnace of firebrick similar to the retorts in gas houses, would be capable of generating fifteen thousand cubic feet per day. The ends of the retorts must come a little outside of the furnace, and must be so contrived as to receive the steam in one end, through a tube which can be regulated by a valve, and another tube from the other end through which the gas passes into a cooling vessel, and from thence into the balloon. One end of the retort must be provided with a bolt-head which can be taken off and put on when required, for the purpose of taking out the residuum and introducing fresh iron turnings. Gas made by this process is pure and inodorous, and is fourteen times lighter than common air, and will give seventy pounds ascending power for every thousand cubic feet.

CARBURETTED HYDROGEN.

As stated in the preceding article, this also is an economical preparation, where things in regard to inflating balloons may be kept at one place. However, this kind of gas being so generally introduced through the streets of all cities and towns, its use to the aid of aeronautics is destined to become an important branch of its consumption. The companies generally have large gas holders at their works, from capacities of twenty thousand cubic feet up to one hundred thousand, and some to a million. In the smaller works, a day or two's notice for a supply sufficient to inflate an experimental balloon of eight or ten thousand cubic feet capacity, would enable them to work into their gas holder that much more than their regular consumption, without injury or inconvenience to their works. In the larger works, as they exist in our principal cities, such a quantity would scarcely be noticed in their regular operations.

This gas is evolved from bituminous coal, subjected to a red heat in iron retorts—and of late they have commenced introducing *earthen* retorts for such purpose. The process is very simple, as heat alone evolves the gas, together with some tar and ammoniacal liquor, which is deposited as soon as it gets to a cool place, and the gas for purification is passed through dry lime. It can also be purified by passing it through wet lime, as described in the vitriolic process. It is composed of two atoms of hydrogen, and one atom of carbon. The first portions of the gas as it is evolved from the coal, is heavier than the latter, but its general specific gravity is about one-half that of atmospheric air. A ton of bituminous coal will yield ten thousand cubic feet of gas sufficiently carburetted for illuminating purposes, and will yield considerably more of a *lighter* specific gravity, which would answer admirably for balloons, but which is never extracted by the gas-lighting companies, on account of its want of carbon, and consequent poor illuminating power.

It may yet become a business question with the gas-lighting companies whether they may not, profitably to themselves, erect a gas-holder expressly to collect these *lighter* portions of the gas to supply aeronautic purposes—especially in the larger works. From the gas, as now manufactured by the baking of bituminous coal, we can get one-half of atmospheric buoyancy, being thirty-five pounds ascending power for one thousand cubic feet of gas. Hence, a balloon capable of carrying an ordinary sized man should not be of a less capacity than ten thousand cubic feet. This would be sufficient to allow for expansion of gas where the balloon attained a height of one and a half miles. But by a very simple process, and by the additional cost of probably an amount equal to first cost, it could be rendered nearly twice as powerful in its levity, by extracting its carbon from it, in running it through heated earthen tubes. Indeed, the art of gas-lighting, like the art of aeronautics, is just at the present time opening itself to the uses of mankind in a tangible manner, and is, as it were, but on the threshold of common comprehension. Its onward progress is destined to carry on its wings the barque which shall glide us from clime to clime as smoothly as the vapor cloud.

For an aeronautic establishment, a gas work could be erected which would render the cost of inflating balloons with purified gas a comparative trifle, compared to what it is at present. Such an establishment in any of our large cities would soon pay a profit equal to the best gas-lighting company's stock. The recreative effects upon invalids would soon bring it into repute far beyond any other means that have been yet established for such purposes; to the elucidation of which a chapter will be specially devoted in the concluding part of this work, since the author himself has been a case of chronic dyspepsia, and can therefore speak from experience.

It should have been mentioned in the vitriolic process, that zinc, in a granulated or otherwise divided state, answers quite as well as iron for decomposing water.

CHAPTER V.

Directions in balloon sailing—Grappling irons—Guide line—Index—Instruments—Descent on woods and waters—How to manage—To collapse balloon—How to fasten grapple ropes—Caution after descent—Folding of balloon—Height instrument—Parachute—How made—Parachutes in the vegetable and animal kingdom—Pope's and Darwin's ideas.

Having a description of the process of making and inflating balloons, our next object will necessarily be to learn their management while using them as a means for navigating the atmosphere. In order to be fully prepared for an experimental voyage, the aeronaut should be provided with two grappling irons of about two and a half pounds weight each; or they may be heavier if he is not particular in the economy of carrying weight.—The ropes attached to these irons should be from two to three hundred feet in length, and should be strong enough to bear a strain of four or five hundred pounds. A short rope of thirty feet, capable of bearing a strain of a thousand pounds, should be carried along to attach to the strongest grapple instead of its thinner rope, to be used when a landing is to be effected under a strong wind. But in such case it is better to choose a landing place behind a hill, or a wood, which forms an excellent harbor for the balloon, and which can as readily be attained by the practical aeronaut, as the bay or breakwater can by the argonaut or water sailor. A line of six or eight hundred feet, capable of bearing a hundred pounds strain, should also be carried along, which answers a very good purpose when descending in calm weather, as by this the aerial vessel may be moored to any required place by any person who may be at the point of its descent. This rope also answers another useful purpose. By having light ribbons tied on it, one at its lower extremity, one a hundred feet higher up, and a third another hundred feet above that, the aeronaut can tell the direction of a contrary current that he may be descending into, some time before he reaches it, a knowledge of which may be very essential to his proper and safe landing.—He should also be provided with an index of rising and falling. This is a light ribbon a foot long, fastened to the end of a three feet stick, which may project from the side of the car. When the balloon rises the ribbon hangs straight down and is tremulous; when the balloon descends the ribbon coils upward, and under a rapid descent it *stands* straight upward with a tremulous motion. Pieces of paper thrown overboard also indicate the rise and fall of the machine, but not so well as the index; for, when the vessel is sailing along in equilibrio, neither rising nor falling, paper will still descend, but the index ribbon does then not move, it hangs perpendicularly down and quiescent, apparently as perfectly becalmed as though it were in an exhausted receiver; and it makes no difference whether the balloon is at the time sailing at the rate of one mile per hour, or at the rate of one hundred miles per hour.

When the aeronaut is sailing along with the wind, his vessel becomes part and parcel of that element as far as velocity of horizontal motion is concerned, and the whole machine is relatively becalmed; therefore, it is plainly seen that sails or rudder would be of no avail under such circumstances. The aeronaut experiences no cutting breeze, as does the traveler on a steamboat or railroad car.

A compass and map should always be carried along to enable the aeronaut to tell where he is going, and the nature of the country over which he is sailing. When immediately above the clouds, the aerial ship sails in the same direction with the clouds, and in such cases it is impossible to tell what direction the balloon is making, or whether it is making any headway at all.—I have sailed in the current which moved the clouds immediately beneath the air ship, and made headway at the rate of fifty-two miles in forty-two minutes, without at the time seeing that I was going at any velocity at all. This is easily comprehended, since the clouds that were with me at the start, were also with me at the end of the voyage, so that everything held the same relative position during the whole flight. When the clouds are broken so that the aeronaut can see the earth at places, it is otherwise, for he can then see objects moving as it were. But, when the air ship is permitted to rise a considerable height above the clouds, it generally gets into another current, in which case the course of the clouds forms an angle with the line of direction of the balloon, which enables the aeronaut to tell his course, as well as his speed, which he is at the time making.

After the aeronaut has sailed as far as he desired, or reached his point of destination, his next object will be to effect a good landing. If he is a novice in the art, some difficulties may beset him, since *practice* is the only school in which we can acquire substantial learning, but at the same time proper directions will be of great use to this branch of the business. If the balloon happens to come down when all the ballast has been expended, it will then be impossible for the aeronaut to govern its descent to any degree. He may avoid coming down on an isolated object, by exerting against the air a common fan, sufficient to diverge from such point, so as to escape a tree, or a house, if it should be in the way. But a river or forest he cannot avoid under such circumstances, and he should not, therefore, be alarmed. If he come down on a forest in a strong wind the car will rebound the moment it strikes the elastic branches of the tree tops, and the machine will thus *ricochet* along without any unpleasant consequences to the aeronaut, and at the first clear space he can make his descent. On such occasions he must remember to keep his grappling irons inside of his car until the moment arrives for their use. If the balloon happens to come down on a river or lake, there is no cause of alarm, as the car will not sink many inches in the water, and if it is in the form of a boat it will sail as well on the water as it did in the air, the balloon acting as a sail. If it be calm weather, the car or boat may be paddled along with very little effort. If the weather is calm, in coming down on a woods the aeronaut can easily guide his bark by the tree tops to such point where the most room presents itself to let the balloon through as it gradually collapses.

The balloon may be provided with a collapsing rope, which I would recommend to novices, since they might become unnecessarily alarmed in a first adventure when landing under a high wind. A common twenty-three feet diameter balloon, upon which all our directions are based, will chafe very fiercely under a gale of wind when the grapple has taken effect. In such case the explosive cord may stand the inexperienced aëronaut in good need, as by a sudden jerk of it the balloon can be exploded instantly, when it falls to the ground powerless. This consists in fastening a stout line securely against the outside of the balloon at a point a little below its equator—from this let it run up four or five feet, or more, there enter the balloon, at which entrance it must be secured by cementing a piece of oiled silk over the aperture to make it air tight—from this point the line or cord proceeds down through the neck of the machine into the aeronaut's car. It must be marked to distinguish it from the valve cord, as they are about of the same strength.

The anchor ropes, or more properly speaking, the grappling-iron ropes, must be fastened at the upper edge of the car, as then, when the balloon draws one way the grapple draws the other, and these two forces being in opposite directions and both proceeding from the same point, the car is not much disturbed by it. To fasten the rope at the bottom of the car, as has frequently been recommended, would, in a heavy wind, cause it to be tilted over.

When the aeronaut has made his descent and is discharging the gas by the valve, he should not leave the car until the balloon is nearly exhausted. Though many persons may come to the place of his descent and become engaged in rendering him assistance, still, if they have been unaccustomed to such operations, they are very apt to become alarmed when a squall of wind happens to agitate the balloon, and let it go. This happened to me on one occasion when the balloon was more than two-thirds exhausted. I had the top of the balloon drawn down and had hold of the valve, when a squall of wind alarmed the persons who held by the cords, which they let go, and, seeing this, I held firmly to the valve disk, but the machine rolled off with a violent surge, jerking me several feet from the ground, and leaving in my hands the whole valve with part of the balloon remaining to it, and from which cause it came down again after it had drifted off nearly two miles.

After the balloon is emptied of its gas the net should be taken off, then it may be rolled up and packed in a canvass bag, or one made of stout twilled muslin, which the aeronaut should always carry with him.

These are general directions and recommendations suggested to the young practitioner of aeronautics, upon which it is desirable he should improve as fast as the progress of the art will inspire him to do. As for philosophical instruments, log-books and journals, he will of course exercise his own pleasure and judgment. The barometer is an instrument which it is very difficult to carry along and bring down safe in rough weather. It should be suspended from the concentrating hoop, and there it is even liable to derangement when landing under squally weather. As an instrument for measuring altitudes based upon the diminution of atmospheric pressure, I have used a common porter bottle, to the neck of which was joined a bladder of the same capacity as the bottle. The bottle being filled with air of the density at the point of starting, and the bladder tied on then in a collapsed state, the expansion of the air in the bottle would gradually fill the bladder as it rose up in the rarer regions of the atmosphere. When the bladder became completely distended it indicated a barometrical height of about fifteen inches, or over three miles high from the level of the sea. A height indicating instrument might be made on this principle, which would tell it with as much exactness as the barometer, and would not be so liable to derangement as an aeronautic instrument. The one I used would only tell one point with exactness—that at which the bladder became filled, the intermediate points were merely calculations from guesswork of the amount of distension in the bladder.

To explode the balloon when high in the air and convert it into a parachute, the manner of doing it, and the fixtures necessary to its operations, have all been described. The parachute, as a distinct machine from the balloon, will be our next subject of consideration.

PARACHUTE.

The concave parachute, for experimental and scientific illustrative purposes, may be considered the best. This can be formed of almost any kind of cloth material, but common domestic muslin, of a substantial texture, answers the purpose very well. One sufficient to let down an ordinary sized man in safety should be twenty-two feet across when opened, and should be of a shape considerably more flattened than a hemisphere. If of a hemispheric shape, it need not be more than twenty feet across when opened, as this form will condense a column of air more rapidly than a flatter form will in its descent. This calculation is for a minimum size, which may be increased by the aeronaut as he fancies, since an increase of size will cause a corresponding retardation of velocity in its descent. The segments of which the parachute is to be formed may be cut by the scale for cutting balloons, and may be so varied as to give it a more flattened form than a half sphere. These segments may be joined by a lap, or a welt seam, according to fancy, since its object is merely strength. The parachute may be covered with a net, or with cords. The latter is the most simple, and answers the purpose perfectly well, when properly arranged. The apex, or central joining of the parachute must be formed of a block of wood with a hole through it sufficiently large for a rope to slide through. The cords which sustain the car of the aeronaut are fastened to this block and proceed down along each seam on the outside of the canvass, and should be fastened along the seam, and at the edge of the parachute where they pass over it. The car is rigged to these cords as represented in the plate of Hampton's parachute, and is supported by the rope with which it is fastened to the balloon, and which passes up through the hole in the block. When the parachute is detached from the balloon, by loosening this rope there is some danger of the rope flying against the inside of the parachute and injuring it. To obviate this, it may be guided safely by passing it through tin tubes setting upon each other from the car to the block, which fall away as soon as the parachute is detached from the balloon. For the further security and certainty of the immediate opening of the parachute, a six-feet diameter hoop may be suspended from the inside of the block, which will keep the parachute that much open, ready at once to receive a column of air in its descent. For safety and certainty Mr. Hampton's parachute is the best.

It has been suggested by some writers on this subject that the parachute be made with a shutter or valve in its top, thinking that such contrivance would answer to regulate its descent in making it uniform, and prevent the violent oscillations which arise from the condensation of the atmospheric column upon which the machine acts when coming down. This method promises very well in theory, as a column of air rushing up through the open shutter of the parachute as it was falling, would seem to act the part of a guide pole, over which the machine would slide down perpendicularly with a uniform motion. But when we consider the elastic nature of the atmosphere, and the very exact proportions of the opening for the column of air to pass through to that of the surface of the impinging material and the weight which drags it along, and then its liability of falling through various air currents which would strike it laterally, it would seem to promise but little advantage in practice. However, it would be worth the trial, and, although parachuting seems to be of no great practical consequence to the art of aeronautics, its science embraces the highest mathematical considerations and properties connected with it.

We have a beautiful illustration of this principle in various departments of nature. The flying squirrel moves in parabolic curves from tree to tree on the parachute principle. The pollen of plants is carried from one place to another by this mode; the beautiful parachutes springing from the common thistle and the dandelion plants have been noticed by the common observer; indeed, nature uses the atmosphere as its common highway, upon which it has, continually, myriads of its vehicles floating for the purpose of interchanging, interpregnating, and improving the vegetable kingdom, upon the aeronautic parachute principle. The phenomenon of frequent occurrence, and erroneously believed to be a deposit of sulphur, which is frequently seen on the surface of our rain-water casks after thunder showers, is nothing more than a deposit of pollen which has been caught with its parachutes in the stormy elements, and which destroyed the little air vessels and dashed the pollen down with the rain, and which for a long time was viewed as a mysterious freak of nature. In the ocean we also have the principle naturally illustrated. The nautilus, and sea anemone, move altogether on this principle. The former embraces the principles of navigation and parachuting, and Pope very beautifully says of it—

"Learn of the little nautilus to sail,
Spread the thin oar, and catch the driving gale."

If nature works upon this principle so extensively, it is certainly well worth our while to study it deeply, since it is well known that our highest attainments in the arts and sciences are but attempts to imitate nature in her more perfect works. By so doing we shall soon realize the prophetic expectations of Darwin, expressed in his inspired poetry of—

"Soon shall thy arm, unconquered steam, afar
Drag the slow barge, or drive the rapid car;
Or, on *wide waving wings expanded*, bear
The flying chariot through the fields of air!"

And if not by steam power, by some power more adaptable to the ends of aerial navigation, which the progressive spirit of the present age is fully competent to bring out.

CHAPTER VI.

Rarefied air balloons—Laws regulating them—Their powers considered—How to construct them—How to inflate them—Experiment illustrated—An ascent with one described.

RAREFIED AIR BALLOONS.

ALTHOUGH rarefied air balloons have almost fallen into disuse, since the hydrogen balloon has been rendered more available as an aeronautic machine, still, a description of the mode of manufacturing and inflating them should be imparted to the student and experimentalist of the art.

The ascent of rarefied air balloons is governed by the same pneumatic law which applies to hydrogen balloons. The means by which the machines are rendered specifically lighter than common air, are, however, very different. In the hydrogen balloon the buoyant agent is a permanent body, unchangeable in its nature under ordinary circumstances. In the rarefied air balloon this agent is not permanent, but dependent on another, which requires a continuous application of combustible material to keep up its buoyant property.

Common air expands by heat and contracts by cold. When a body or portion of it is heated more than that by which it is surrounded, it will rise, and if it is rendered colder it will sink in it. On this principle the rarefied air balloon depends for its buoyant power. Common air increases one-four-hundred-and-eightieth of its bulk for every additional degree of heat it gets, and since its weight is as its density, it follows that this increased bulk weighs one-four-hundred-and-eightieth less than an equal bulk of air whose temperature is one degree less. Consequently, as we increase the temperature of the air in the balloon, so we increase its ascending power, and so long as the temperature exists, so long its proportionate ascending power continues, and as soon as this temperature diminishes, so soon also diminishes this power. Hence, in order to keep a rarefied air balloon afloat in the atmosphere any length of time, it becomes necessary to carry with it fuel for the purpose of keeping up the heat of the air with which it is filled. If we send them up with a heated body of air in them, and no fire along, their flight must be necessarily brief, as an equilibrium between the enclosed and outer air will soon follow in the high and colder region of the atmosphere to which they will be driven. The rarefaction of common air by this process, seems to come justly under the principle of dilution, since from a given body of common air a portion is expelled, and in its stead a lighter substance (caloric) is placed. On the same principle, that if we take a bottle full of water and force into it, while it has vent, a portion of spirits of wine, a part of the water will be expelled, and the bottle will be filled with a compound fluid specifically lighter than water, and if the bottle were porous, as is the case with the rarefied air balloon, and placed, or immersed into a body of water, an equilibrium would soon be brought about between the inner and outer liquid, unless some contrivance attended the bottle, by which a stream of spirits of wine was forced into it faster than the diffusion of the liquids would compensate for. Hence, by increasing the temperature of a given quantity of confined air, we drive a portion of it out, and put in its place an equal bulk of caloric. The latter substance is the *material* cause of heat, and occupies space.

As common air is expanded by heat to the extent of one-four-hundred-and-eightieth of its bulk for every additional degree of Fahrenheit it attains, it follows that a balloon whose capacity is one thousand cubic feet, and filled with air one degree warmer than that which surrounds it, must be one-four-hundred-and-eightieth lighter than the weight of an equal bulk of that which it displaces. Now, as common air weighs one and two-tenth ounces per cubic foot, a thousand feet weighs twelve hundred ounces, and the one-four-hundred-and-eightieth part of that makes two and one-half ounces, so that for every additional degree of heat put into this quantity of air, we drive out two and one-half ounces of ponderable matter, and occupy its place with caloric or imponderable matter. Increase this heat to a hundred degrees above its common temperature—being that of the atmosphere at the time of making the experiment, and we shall have gained sixteen pounds ascending power nearly. If the atmosphere at the time of the experiment is fifty degrees, the heat inside the balloon will be one hundred and fifty degrees. If we use a balloon of ten thousand feet capacity, we will, at this rate, gain an ascending power of one hundred and sixty pounds nearly, and from this we see that rarefied air balloons must be made of very large dimensions in order to carry up aeronauts, as it is not very practicable to attain a degree of rarefaction much beyond that which we have just mentioned. And in order to succeed in going up with one, it should hold from fifty to sixty thousand cubic feet. The only one that I ever saw used in the United States with which a person ascended on this principle, held about sixty thousand feet, and the aeronaut carried no fire up with him.

CONSTRUCTION OF RAREFIED AIR BALLOONS.

Common stout muslin answers the purpose very well, and in order to make it retain the heat better it should be coated slightly with a composition of common ochre, glue and water, made into a consistency of what is termed *size*, or common water color.—Before this is put on, the lower part of the balloon should be soaked in a solution of alum, or sal ammoniac, which renders it non-combustible, and avoids the danger of the machine taking fire while in process of inflation. The segments should be joined by a lap seam substantially sewed, which makes the machine firm, and it must be remembered that the rarefied air balloon carries no net-work over its surface, therefore, its main strength must depend on the material it is made of and its seams. The form of the balloon should be oblong, of such proportions as when the machine is forty feet in its transverse diameter it should be sixty feet in its perpendicular diameter. This dimension is a convenient size for one to carry up an aeronaut. To form such a one the segments must be cut by a pattern for a forty feet diameter balloon—that is the upper half of them—their central parts straight, making its shape cylindrical one-third of its height, and the lower parts tapered off, so as to finish the machine with an opening in its lower part of thirteen feet four inches, being one-third of its transverse diameter. This makes the machine globular at the top, cylindrical along its middle, and egg shaped in its lower part. In the lower orifice a hoop of tough wood must be inserted, and as this carries the whole weight of the aeronaut and his appendages, it is best to make the lower part of the balloon of stronger material, for a distance of five or six feet up from the hoop. This hoop need not be sewed in, if the lower edge be worked full of loop holes, by which it may be strung fast with stout twine. From this hoop proceed the cords, in the same manner as they are described to do from the net of the hydrogen balloon; and the same rule and rigging from this point apply in both cases.

The foregoing plate represents a sectional view of a rarefied air balloon in process of inflation. A Frenchman by the name of Verdalle made several ascensions with a balloon of this kind from the vicinity of the city of Philadelphia in the fall of 1849. His machine was about forty by sixty feet in size, and was composed of black twilled muslin. When prepared for inflation it was suspended from a rope which run across from two poles erected for that purpose, so that just before starting he could loosen the one end of it and draw it out of the ring at the top of the balloon.—The process of inflation on the occasion where I was an eye witness, was conducted in the following manner:—

The balloon was suspended from a rope as represented above—its lower part touching the ground. Inside of the balloon on the ground stood a common sheet iron furnace surmounted with a flue about six feet high. Near the balloon on the outside was provided a quantity of straw, about a common cart load, tied up in suitably sized fagots. These were handed through under the hoop, which was held down close to the ground by assistants, and only raised when necessity required it. In the inside were other assistants who took the straw and fired it through the furnace, the blaze striking out at the top as represented in the plate. One of the inside assistants was provided with a sheet iron paddle of sufficient size to cover the opening of the flue, which acted as a damper. This became occasionally necessary from the intensity of the fire and discharge of flakes and sparks. Several times these flakes did ignite the balloon in small points, but it was as often pulled down and the fire extinguished, which burned slowly and without a blaze, owing to its being prepared with noncombustible glue-size. There was also in readiness a demijohn full of spirits of wine with which to saturate the straw fagots at the close of the inflation, for the purpose of raising the rarefaction in the balloon to the highest degree at the time of starting, as Monsieur Verdalle carried no fire up with the machine to prolong his voyage with. After the balloon was fully distended with heated air, the rope by which it was at first suspended was withdrawn, and the car was at the same time attached, on which the aeronaut mounted, when the huge machine was released and it mounted quickly but gracefully into the space above.

This ascension was made near sunset about the middle of October. The evening was calm and clear. The balloon ascended over half a mile in height, which it attained when about a mile off from where it started. It then commenced descending, coming down with a gently accelerated velocity, and landed about two miles from where it started. When it struck the earth it fell upon its side, which made it evident that the air then contained in it could not be much rarefied. In descending it would of course have a column of cold air rushing into it all the time, which would soon bring the air it contained to the temperature of the surrounding atmosphere, and the latter part of its descent would be regulated by the resistance of the air to falling bodies, which in so large a surface as presented in the machine just mentioned, would soon stop its acceleration.

Although these kind of balloons hold no comparison to those of the hydrogen principle in aeronautic improvements, but as a means of demonstrating aerostatic principles they are very convenient and economical. Such a machine as the one just described can be inflated sufficiently to carry up a man, and the whole cost of such inflation would not exceed five dollars. And beyond such use they are not to be recommended, since, in order to make long voyages with them, fire must be carried along, which makes it very dangerous, unless some better mode than that of carrying it along on an open brazier will be invented.

True it is, that we may discover a means by which caloric may be retained or confined in non-conducting vessels the same as we now retain hydrogen. Such a method once discovered, and a vessel invented for its use, we may easily conceive a further discovery by which caloric might be abstracted from the surrounding atmosphere as we traveled through it and required it for use. Such a principle, and its use as above described, is as compatible with the laws of nature and progress of science, as was the discovery of the common water pump and its application to common use, by merely destroying the equilibrium of the atmosphere between the inside and outside of the pump. In the case of the balloon it only requires a destruction of equilibrium of the caloric inside and outside of it. Even the levity of hydrogen is owing to the superior affinity of the atoms of which it is composed for caloric over those of nitrogen and oxygen, which mainly constitute our common atmosphere. Indeed, chemical science is opening the door to the highway of aerial travel.

CHAPTER VII.

Pilot balloons, how made—How coated with oil—How to inflate them—Gum-bag balloons—Devices—To soften gum-bags—To distend them—Small fire balloons, to make—Philosophical principles which govern their ascent—To make them ascend—Things can be sent up with them.

PILOT BALLOONS.

The small balloons which are generally sent up at balloon ascensions, to show the various directions of the upper currents of the atmosphere, are called pilots. They may be sent up inflated with hydrogen gas, or with rarefied air. The former kind are generally used as pilots, and the latter as toy balloons, made and sent up for mere amusement, with sometimes a piece of fireworks attached to them, which produces a very brilliant effect of a dark night. Those made to ascend with hydrogen need not be more than eighteen or twenty inches in diameter to make them capable of ascending, and are made in the following manner: Take good close tissue paper (the English is the best) and cut it into segments suited to the size of the balloon to be made. These are then cemented together with a solution of gum-Arabic. The segments should be cut so as to form a neck to the balloon when it is completed. In pasting them together the segments should first be folded once longitudinally, then by placing one on the other so that its edge is a little behind the lower one, the gum can be spread along the projecting edge of the lower one, when it can easily be folded up and over the edge of the upper one.—Then another one is placed on the top of the upper and the same process gone through with, which is continued until all the segments intended for the balloon are put together, when the edges of the lower and upper segments are to be joined, which completes the machine in a regularly folded manner. Care must be taken while the joining is going on so that the folds are not pasted together, which may be avoided by running the finger between them occasionally as the work is going on. When the balloon is done its neck should be lined around its lower edge with a strip of muslin about a half an inch wide, so as to prevent it from tearing when it is placed over the tube from which it is to be inflated. Before they can be inflated and sent up they must go through another process. Paper of any kind is too porous of itself to retain hydrogen gas. Therefore, just before they are to be used they must be coated with common linseed oil, which can be spread on with a soft brush or tuft of raw cotton: this can be done very handily by laying one fold out after the other, so that when the pilot is oiled all over it is folded up again as it was when the oiling was commenced. The pilot unfolds itself as the gas is introduced. A pilot of two feet diameter made in this way and inflated with hydrogen and its neck tied up, will ascend up to and through the clouds—the porosity of the envelop will allow an escape of gas adequate to its expansion as it rises.

Devices of men, animals, fishes, &c., can be made in this way, and sent up. A corpulent figure, representing the "Flying Dutchman," and sent up on occasions of balloon ascensions, has invariably produced a high degree of satisfactory merriment.

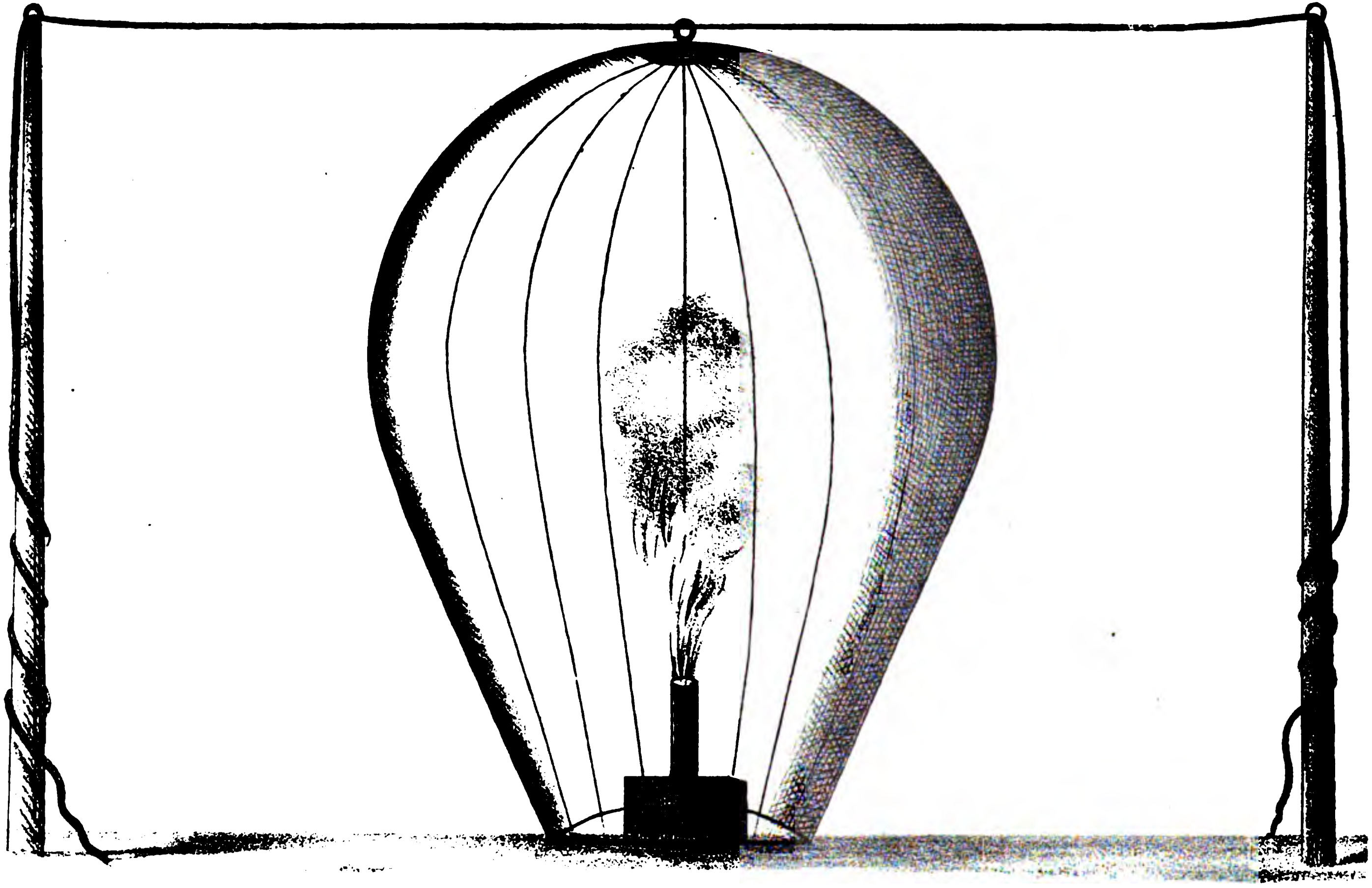
Small hydrogen balloons of two or three feet diameter, can be made by an expert hand from the common India rubber bottles which are kept at almost every drug store. These retain the gas for a long time. Some years ago one of this kind was made by Professor J. K. Mitchell, of Philadelphia, and sent up from there, which went some hundreds of miles before it descended, and then caused quite a consternation in the neighborhood where it came down, which, if my recollection serves me right, was at the head-waters of the Potomac river. They are made by the following process:—the gum-bag is filled with ether and also placed in a vessel of ether so that all its surface is exposed to the solving liquid. When it gets soft, which may be in a day or two, according to the strength of the ether and the nature of the gum, and which must be looked to from time to time, the bag may be taken out and emptied of the ether and blowed up. This is the most critical part of the process. Some parts may be more softened by the ether than others, and these will consequently expand faster than the others, therefore, these parts must be protected, and the thicker and stubborn parts may be from time to time dipped into some ether. By placing the hands on the thin parts when blowing into the bag, these parts will be relieved and the stress exerted upon the rest of the surface. A few experiments by a skillful hand will enable him to make them nicely. Care should be taken to select the most perfect bags. The bag may be weighed, upon which it will be ascertained to what dimensions it must be expanded to make it light enough to carry up what it is designed for when inflated with hydrogen. When it is sufficiently expanded it should remain a while in that form, so as to give the membrane that set.

SMALL FIRE BALLOONS.

These are nothing more than rarefied air balloons, and get the appellation of "fire balloons" from their always being sent up with fire in them. Small ones of this kind are made of the same material and put together in the same manner as the hydrogen pilot, of which a description has already been given, only that the fire balloon need not be oiled. The same proportions as set down for the large rarefied air balloon may be observed in these small ones. They may also be made globular, but the most convenient shape is the egg shape, that is like an egg with its pointed part cut off. They are generally made with long necks, which is wrong, and is the cause of them taking fire, and so frequently failing in getting them off at all. These misconceptions arise from a want of the scientific knowledge which governs the art. Indeed there are many mechanical geniuses who are entirely ignorant of science, and this desideratum makes them throw away many an hour and many a day, by which they might adorn their characters and elevate their class, and the race of mankind, if they had also studied philosophy with their arts.

Fire balloons should never be made of less dimensions than three feet diameter. Though they can be made and elevated of even smaller size, still, it requires a good deal of care and nicety, and delicate construction, to make one of three feet diameter ascend handsomely. The experimentalist, if he be a novice in the undertaking, had better make his machine larger than three feet, and success will then be easier attained. By making it still larger, say ten or twelve feet in diameter, he need no longer confine himself to tissue paper, as he may use some heavier and cheaper, though tissue is the best. Some few years ago a lady made an ascension from Padua, in Italy, with a tissue paper fire balloon covered over with a net-work. We may presume she carried no fire with it. The account of it stated that the balloon bursted in coming down, but the lady came off with no other injury than a considerable jar.

In making small fire balloons we must not calculate on more than one-third of an ounce of ascending power for every cubic foot of capacity in the machine. Thus, if we look at the table of capacities and dimensions of balloons, we find a three feet



P. S. Duval's Steam lith Press.

RARIFIED AIR BALLOON.

diameter one to contain fourteen cubic feet. Hence, one of this size with air highly rarefied would raise about five ounces, and hence, if the balloon and sponge containing the alcohol weigh more than five ounces it will not rise, at least not by raising the temperature of air in it one hundred degrees above its surrounding atmosphere. Thus it will be seen that an experiment of this kind tried on a small scale requires to be conducted with a degree of nicety and skill, which becomes less imperative as the magnitude of it is increased.

In the construction of small fire balloons a light wooden hoop, or it may be of light wire, must be inserted in its mouth so as to keep it apart. Two cross wires must be fastened on this hoop, and where they cross each other there may be a little wire cup or basket formed in which to place the cotton ball, or sponge, which contains the spirits of wine. A ~~lug~~ Lump of cotton tied round and round with thread to keep it more together answers very well, and I have generally preferred it to sponge. To send one up when of a small size, a quantity of alcohol, more than it is able to carry, may be placed in the wire basket, which will inflate it and in the mean time grow lighter, so that by the time the machine is properly inflated and rarefied its fire burden will have become light enough to be carried up by it, and there will at the same time be remaining enough of fire matter to keep up the rarefaction after the balloon has started. Besides this, the burden continues to get lighter on its voyage as the matter in the basket consumes. In machines of a larger size, a small furnace capped with a stove-pipe or other kind of tube may be used, by consuming paper or straw in it, or anything that gives out little smoke and much heat, which will inflate it with more economy than alcohol, and the latter substance may be applied to the basket just before the machine is let up. Such as these may have parachutes attached to them with small animals, and regulated by a slow match to burn off the string which connects the parachute with the balloon.

CHAPTER VIII.

General remarks on the art—Philosophy of varnish-coating to render stuff impervious to gas—Experiments on the diffusion of hydrogen in balloon—Escape of experimental balloon—Double envelop prepared well, would retain gas long enough to go round the world with—Aerial voyages are life conservative—Its philosophy considered—Its effects as experienced.

Having detailed the manner of constructing and managing balloons on the most improved methods, some general remarks will properly conclude this part of the work.

Gold-beater's skin has been highly recommended by some persons, as making a very impervious envelop for gas. I have tried this and found it even inferior to varnished silk or muslin. It seems that all animal membranes are porous and naturally adapted to the passage of gases and liquids. The membrane of lungs lets the oxygen of the atmosphere pass through while it obstructs the atoms of nitrogen with which the oxygen is diluted. Animal membranes have a peculiar texture, adapted to the transmission of some liquids and gases, and not to others. And there appears to be a peculiarity of shape, size, or roughness to each gas, to which the porosity of any substance must be adaptable in order to let it pass through. The very best method that I have yet discovered to effect this, is to coat the material intended to retain the gas with linseed oil varnish in very thin layers. If put on thick in one coating it seems to get porous in drying, and so will a thin coat, but by repeated layers each succeeding one will cover over the pores of its antecedent.

This nature of porosity applies also to membranes of gum elastic, and when this substance is to be used for gas envelops it makes a more impervious coating by being laid on in repeated layers, than when put on in one heavy coat. The affinity which gases have for each other is remarkably strong, and in some cases, it will pervade any substance that may intervene.

I made an experiment with a silk balloon which held thirty cubic feet, coated like the balloons commonly used by me for ascensions. This was filled with hydrogen evolved from water by sulphuric acid and iron turnings, and fastened to a weight in the cellar—there being a circulation of air through the cellar as in common cases. The first, second, and third days the balloon gradually diminished its bulk, and its greatest diminution was about one-tenth, and it also lost about one-tenth of its ascending power. The fourth day it seemed to be increasing its bulk, and the fifth it was very perceptible. On the sixth it was nearly as full as it was when first put down, and on the seventh it showed that it would burst if suffered to go on increasing in bulk in the same ratio a day longer, upon which I relieved it by opening its neck, which had been well tied up, and then it soon lost its ascending power. Before I opened the neck I tried its ascending force and found it had not lost as much the three last days, as it had the three first.

This same balloon was taken and re-coated three times more, but the whole of these coatings did not increase its weight quite half as much as the whole weight of its former coating amounted to. Upon being filled again with hydrogen, it did not lose as much in the first ten days, as it had on the former occasion in thirty-six hours. After this it was used for several days in electrical experiments, during which it got off with several hundred yards of twine, and I never heard of it afterwards. It must, soon after its release, have got vent sufficient to allow an escape of gas by expansion, but may have reached the Atlantic before it came down, as the last course it was seen sailing was due east, and it had but one hundred and thirty miles to go in that direction to get to sea.

To make a balloon that would retain its hydrogen for months, or a greater length of time, out of cloth material, it only requires the substance to be coated, silk or muslin it may be, in thin layers; and from experiments, I find that two layers of silk or muslin, coated in this way and laid together, so as to make a double envelop, increases its imperviousness in a remarkable degree.

AERIAL VOYAGES ARE LIFE CONSERVATIVE.

If aerial navigation, or ballooning as it is, had not the strong claims on our energies and encouragements from the auspicious developments that are now so rapidly succeeding each other in the arts and sciences, it would of itself, in its present simplicity, command an attention and desire to seek its use, as we seek life itself, were it only generally and properly comprehended in its health-promoting, life-saving, and soul and body invigorating capabilities. Human beings will seek distant climes under all the tortures and enervating vicissitudes of long and perilous sea voyages, for the purpose of relieving their constitutions from the devouring effects of chronic diseases, but many of them only attain their graves in the silent deep while in search of the goal of health. The elysian fields of health are much easier to be found by the use of balloons. Milton says:—

"The river of *life*, through midst of heaven,
Rolls o'er elysian flowers her amber stream."

And if Milton had never expressed the idea in his heaven-born poetry, the laws of life, and the philosophy of its circumstances, would be amply sufficient to sustain what shall be written on this point. With such auxiliaries, in connection with the progressive spirit of the age, the doctrine about being set forth will not be considered vainglorious, but *real* glorious, in the cause of the alleviation of the human family from the pains and evils that flesh is heir to.

That atmospheric pressure has a great deal to do, if not all to do, with the mechanical functions of life, must be admitted by all sound reasoning on the subject, and if reasoning alone will not answer, the *experimentum crucis* is demonstrable by sending chronically diseased persons through the healthy fields of life inspiring air above the earth, and examining the results. From *such* arguments have proceeded my conclusions. When I first engaged in the business of aeronautics I was suffering from chronic dyspepsia, added to a severe affection of the lungs caused by a long continued inhalation of dust composed of rose-wood and the fine particles of glass, arising from the use of glass paper upon such wood, which my business then subjected me to (piano forte making).

From the devouring ravages of such a complicated disease the practice of ballooning relieved me, notwithstanding the perplexities attending the first six or seven years while engaged in it, were of themselves more than sufficient to countervail any ordinary life conserving operations.

That atmospheric pressure has a powerful influence on the lungs, was known long ago. Doctor Arbuthnot, a celebrated English physician and writer says of it:—"The pressure of the air upon the lungs is much less than it has been computed by some; but still it is something, and the alteration of one-tenth of its force upon the lungs must produce some difference in elutriating the blood as it passes through the lungs."

This *elutriation* is the very fulcrum of the life principle—upon that it rises and falls—grows weaker and stronger—languishes or fires up. In the lungs the life principle is generated—they form the medium through which the electricity of life is abstracted from the oxygenated atmosphere, where it is thrown back by their action an asphyxiated death vapor. It is there that *motive* power is acquired and applied through the blood to the heart (the working cylinder and balance wheel of the animal system), which returns like the exhausted steam of a low pressure engine, to be again calorified, or electrified, only to repeat its offices over and over again. This, although perhaps not exactly to be found written in books of animal physiology as here stated, is nevertheless borne out by the present known science of animal life, and identifies the old doctrine of blood oxygenation, with the present, of blood electrization.

The atmosphere exerts a pressure of from twenty-five to thirty thousand pounds upon the human body of full growth, and, if, as Doctor Arbuthnot says, the alteration of one-tenth of this force produces a great difference in the elutriation of the blood in the lungs, such change is acquired at a very moderate height in the atmosphere, and one-fourth, and even one-half the difference of the whole pressure can easily be acquired by the use of balloons. By elutriation he means the changing of the blood from its black to its livid red color. But I hear a scientific voice say we can acquire this change of pressure pro and con by the air pump and condensing machine! So we can, but under very different circumstances from those under which we acquire it in the pure upper regions of the atmosphere! In the exhausted receiver the air would soon become asphyxiated, and every new inhalation would be followed by a discharge of death vapor, to say nothing of the monotony of such a remedy. This is not the case in the upper regions of the atmosphere; there the advantages come even in a stronger ratio, than the disadvantages do in the other case.

Let us consider them. All diseases indicate a want of life—electrical stimulus. I know Doctors say, sometimes men die of too much health. In such cases of disease they might be put under the air condensed process, if the *truth* of such a cause of disease and death could be unequivocally established. At all events if there be such a disease the human family has never yet suffered much from its ravages. However, if it be so, the reverse of the case ought to hold out, that we might get too sick to die, which seems to be neither philosophical nor logical.

Now, as we rise up in the atmosphere there are two causes acting in beautiful harmony upon the invalid calculated to produce the most happy results. While the most sublime grandeur is gradually opening to the eye and the mind of the invalid—the atmospheric pressure is also gradually diminishing upon the muscular system, allowing it to expand—the lungs becoming more voluminous, taking in larger portions of air at each inhalation, and these portions containing larger quantities of caloric, or electricity, than those taken in on the earth, and the invalid feels at once the new life pervading his system, physically and mentally.

—The blood begins to course more freely when up a mile or two with a balloon—the excretory vessels are more freely opened—the gastric juice pours into the stomach more rapidly—the liver, kidneys, and heart, work under expanded action in a highly calorified atmosphere—the brain receives and gives more exalted inspirations—the whole animal and mental system becomes intensely quickened, and more of the chronic morbid matter is exhaled and thrown off in an hour or two while two miles up of a fine summer's day, than the invalid can get rid of in a voyage from New York to Madeira, by sea.

The appetite is extraordinarily affected in a balloon ascension, and this feature of the effects of aerial voyages never diminished in the least with me for fifteen years. It always gave me a ravenous appetite for animal food.

The pneumatic effects as above stated will not be questioned by any person acquainted with the nature of the atmosphere, and the consequent results upon the human system as described, are as natural to them, as it is for night to follow day.

It would seem as though nature itself cried aloud to us upon this subject, inviting us to its elysian fields to drink in the fluid of life and relieve poor enervated humanity.

THE END.

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